US Army Corps
of Engineers
Louisville District

Solicitation For:

USARC/OMS/UNHEATED STORAGE BUILDING FORT STORY, VA

30 APRIL 2003
SFB DACA27-03-B-0004

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IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO. W22W9K-3042-	6. PROJECT NO.

7. ISSUED BY CODE DACA27	8. ADDRESS OFFER TO (If Other Than Item 7) CODE
MILITARY/RESERVE TEAM 600 DR. MARTIN LUTHER KING, JR. PLACE, RO LOUISVILLE KY 40202-2230 TEL: FAX: 502.315.6194	**See Item 7** TEL: FAX:

9. FOR INFORMATION CALL:	A. NAME	B. TELEPHONE NO. (Include area code) (NO COLLECT CALLS)
	SHARON K EVANS	(502) 315-6187

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS (Title, identifying no., date):

USARC/OMS/Unheated Storage, Ft. Story, VA - This project is a new 600 member Army Reserve Center, Organizational Maintenance and Unheated Storage Building to include a 5 year Operations and Maintenance of the MILCON construction

The estimated cost range for this project is between $10 million and $25

NAICS Code is 236220 - $28.5

NOTE: THIS IS AN UNRESTRICTED PROCUREMENT - The Hubzone Price Evaluation Preference applies to this

11. The Contractor shall begin performance within 10 calendar days and complete it within 660 calendar days after receiving [ ] award, [X] notice to proceed. This performance period is [X] mandatory, [ ] negotiable. (See 0800 Para. 1.3 .)

12 A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? (If "YES," indicate within how many calendar days after award in Item 12B.) [X] YES [ ] NO	12B. CALENDAR DAYS 10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 1 copies to perform the work required are due at the place specified in Item 8 by 01:00 PM (hour) local time 19 Jun 2003 (date). If this is a sealed bid solicitation, offers must be publicly opened at that Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee [X] is, [ ] is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 60 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

SOLICITATION, OFFER, AND AWARD (Continued)

(Construction, Alteration, or Repair)

OFFER ***(Must be fully completed by offeror)***

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
	16. REMITTANCE ADDRESS *(Include only if different than Item 14)* **See Item 14**
CODE / FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirements stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)*

AMOUNTS	SEE SCHEDULE OF PRICES

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS

(The offeror acknowledges receipt of amendments to the solicitation -- give number and date of each)

AMENDMENT NO.										
DATE										

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20B. SIGNATURE	20C. OFFER DATE

AWARD ***(To be completed by Government)***

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA

24. SUBMIT INVOICES TO ADDRESS SHOWN IN *(4 copies unless otherwise specified)*	**ITEM**	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C. 2304(c) ☐ 41 U.S.C. 253(c)
26. ADMINISTERED BY CODE		27. PAYMENT WILL BE MADE BY: CODE

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return _____ copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications or incorporated by reference in or attached to this contract.

☐ 29. AWARD *(Contractor is not required to sign this document.)* Your offer on this solicitation, is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*		31A. NAME OF CONTRACTING OFFICER *(Type or print)* TEL: EMAIL:	
30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY	31C. AWARD DATE

Section 00010 - Solicitation Contract Form

QUESTIONAIRE

QUESTIONS REGARDING THE SOLICITATION

Inquiries must be submitted in writing to Contracting Division, Attention: Sharon Evans,
by fax 502-315-6195 or email to Sharon.k.evans@lrl02.usace.army.mil

PROJECT NUMBER AND NAME: DACA27-03-R-0003, CSG Barracks Complex, Ft. Campbell, KY

Date:

Organization:

Originator of Inquiry:

Telephone No: Fax No.:

Email address:

Reference (Section #or Drawing #)

Question:

Answer:

FOR GOVERNMENT USE

Control #_____ Answered by:_____ Phone: _____

Has this inquiry resulted in: ____ Clarification only, no need to change solicitation
____ Need for amendment

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0001		1	Lump Sum		
	BASE FFP Construct a 600 member Army Reserve Center, Organizational Maintenance Shop and Unheated Storage Building including 5 years Operation and Maintenance contract located at Ft. Story, VA PURCHASE REQUEST NUMBER: W22W9K-3042-3937				
				NET AMT	

FOB: Destination

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0002 OPTION		1	Lump Sum		
	OPTION 1 FFP Landscaping				
				NET AMT	

FOB: Destination

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003		1	Lump Sum		
OPTION	OPTION 2 FFP UNHEATED STORAGE AND LOADING RAMP				
				NET AMT	

FOB: Destination

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0004		1	Lump Sum		
OPTION	OPTION 3 FFP ELECTRICAL SERVICE TO THE DEPMEDS				
				NET AMT	

FOB: Destination

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0005		1	Lump Sum		
OPTION	OPTION 4 FFP EMERGENCY GENERATOR AND IT'S ASSOCIATED MAINTENANCE FOR A FIVE YEAR PERIOD.				
				NET AMT	

FOB: Destination

CLAUSES INCORPORATED BY FULL TEXT

LCL 0000-005 SPECIAL BID CONDITION.

If a modification to a bid based on unit price is submitted, which provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price in the bid schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.

EXERCISE OF OPTIONS

Prices for the options shall be good for 365 days after award of the contract. The project duration shown in Section 00800, FAR 52.211-10 COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK shall not be affected by the exercising of the options.

LCL 0000-008 FIELD OFFICE OVERHEAD

NOTICE TO BIDDERS/OFFERORS: For your bid/offer to be responsive, you must declare below the single accounting practice that you apply to contracts to calculate field office overhead for all change orders, modifications, and requests for equitable adjustment. Pursuant to Federal Acquisition Regulations (FAR) Parts 31.105(d)(3) and 31.203(d)(1), an accounting practice that varies from modification to modification is not allowable. Select one of the following:

	CHECK APPROPRIATE LINE
1. TIME DISTRIBUTION BASE FOR A PER DIEM RATE	
If you use this practice, see Special Clause "Field Office Overhead Per Diem Rate"	_____
2. DIRECT COST DISTRIBUTION BASE FOR A PERCENTAGE MARKUP	
If you use this practice, see Special Clause "Field Office Overhead Percentage Markup"	_____
3. OTHER ACCOUNTING PRACTICE THAT IS ALLOWABLE UNDER THE FAR AND USES A <u>SINGLE</u> DISTRIBUTION BASE	_____

YOU MUST DESCRIBE THE ACCOUNTING PRACTICE IN SUFFICIENT DETAIL BELOW TO ALLOW THE CONTRACTING OFFICER TO DETERMINE WHAT ACCOUNTING PRACTICE IS BEING UTILIZED BY YOUR COMPANY AND THAT IT COMPLIES WITH THE FAR.

_____

_____

_____

_____

_____

_____

FAILURE TO FULLY COMPLY WITH THE ABOVE REQUIREMENT OR, IF ALTERNATIVE IS DECLARED AND YOUR DESCRIPTION DOES NOT CLEARLY STATE OR DESCRIBED A CONSISTENT ACCOUNTING PRACTICE USING A SINGLE DISTRIBUTION BASE, WILL BE CAUSE FOR YOUR BID TO BE REJECTED AS NON-RESPONSIVE.

SURETY 2000 PILOT PROGRAM

********SPECIAL NOTICE********

For all states, the U.S. Army Corps of Engineers is conducting a pilot program with Surety 2000, to test electronic surety bond transactions and verification/authentication systems.

Surety 2000 is an Internet-based surety processing, verification and security system, developed in cooperation with the surety industry. Contractors and Surety Agents may contact Surety 2000 toll-free at 1-877-417-6252.

Bidders are encouraged to participate in the pilot program. To participate, the bidder is asked to provide a bidder's bond "Authorization Code" from the bidder's surety agent. The bidder's surety agent is encouraged to contact Surety 2000 to take advantage of the Surety 2000 automated bidder's bond process, which is capable of automatically generating the bid bond "Authorization Code."

The U.S. Army Corps of Engineers will then provide the "Authorization Code" to Surety 2000 to independently authenticate the actual bidders bond, and to document the functioning of the surety 2000 system.

"Authorization Codes" will only be accepted for bidder's bonds, and only as part of the pilot program. During the pilot program, the "Authorization Codes" will not be accepted in lieu of the bidder's bond, or other bidder's security required in the specifications.

The function of the Surety 2000 system is to provide a more efficient method for Contractors to protect their bid security, and to discourage fraud. All U.S. Army Corps of Engineers admitted sureties and surety agents are authorized to use the Surety 2000 system.

The results of the surety 2000 pilot study will be tabulated, and at some point in the future the U.S. Army Corps of Engineers may consider accepting "electronic" bidder's bond verification in lieu of the bidder's bond currently specified.

CLAUSES INCORPORATED BY REFERENCE

52.236-27	Site Visit (Construction)	FEB 1995

CLAUSES INCORPORATED BY FULL TEXT

52.204-6 DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (JUN 99)

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" followed by the DUNS number that identifies the offeror's name and address exactly as stated in the offer.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a

DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

(1) Company name.

(2) Company address.

(3) Company telephone number.

(4) Line of business.

(5) Chief executive officer/key manager.

(6) Date the company was started.

(7) Number of people employed by the company.

(8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet Home Page at http://www.customerservice@dnb.com. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at globalinfo@mail.dnb.com.

(End of provision)

52.211-2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) AND DESCRIPTIONS LISTED IN THE ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST, DOD 5010.12-L (DEC 1999)

Copies of specifications, standards, and data item descriptions cited in this solicitation may be obtained--

(a) From the ASSIST database via the Internet at http://assist.daps.mil; or

(b) By submitting a request to the--Department of Defense Single Stock Point (DoDSSP), Building 4, Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Telephone (215) 697-2667/2179, Facsimile (215) 697-1462.

(End of provision)

52.211-14 NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990)

Any contract awarded as a result of this solicitation will be___ DX rated order; C2 DO rated order certified for national defense use under the Defense Priorities and Allocations System (DPAS) (15 CFR 700), and the Contractor will be required to follow all of the requirements of this regulation. [Contracting Officer check appropriate box.]

(End of provision)

52.214-3 AMENDMENTS TO INVITATIONS FOR BIDS (DEC 1989)

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, (3) by letter or telegram, or (4) by facsimile, if facsimile bids are authorized in the solicitation. The Government must receive the acknowledgment by the time and at the place specified for receipt of bids.

(End of provision)

52.214-4 FALSE STATEMENTS IN BIDS (APR 1984)

Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

(End of provision)

52.214-5 SUBMISSION OF BIDS (MAR 1997)

(a) Bids and bid modifications shall be submitted in sealed envelopes or packages (unless submitted by electronic means) (1) addressed to the office specified in the solicitation, and (2) showing the time and date specified for receipt, the solicitation number, and the name and address of the bidder.

(b) Bidders using commercial carrier services shall ensure that the bid is addressed and marked on the outermost envelope or wrapper as prescribed in subparagraphs (a)(1) and (2) of this provision when delivered to the office specified in the solicitation.

(c) Telegraphic bids will not be considered unless authorized by the solicitation; however, bids may be modified or withdrawn by written or telegraphic notice.

(d) Facsimile bids, modifications, or withdrawals, will not be considered unless authorized by the solicitation.

(e) Bids submitted by electronic commerce shall be considered only if the electronic commerce method was specifically stipulated or permitted by the solicitation.

(End of provision)

52.214-6 EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984)

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

(End of provision)

52.214-7 LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (NOV 1999)

(a) Bidders are responsible for submitting bids, and any modifications or withdrawals, so as to reach the Government office designated in the invitation for bids (IFB) by the time specified in the IFB. If no time is specified in the IFB, the time for receipt is 4:30 p.m., local time, for the designated Government office on the date that bids are due.

(b)(1) Any bid, modification, or withdrawal received at the Government office designated in the IFB after the exact time specified for receipt of bids is “late” and will not be considered unless it is received before award is made, the Contracting Officer determines that accepting the late bid would not unduly delay the acquisition; and--

(i) If it was transmitted through an electronic commerce method authorized by the IFB, it was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of bids; or

(ii) There is acceptable evidence to establish that it was received at the Government installation designated for receipt of bids and was under the Government's control prior to the time set for receipt of bids.

(2) However, a late modification of an otherwise successful bid that makes its terms more favorable to the Government, will be considered at any time it is received and may be accepted.

(c) Acceptable evidence to establish the time of receipt at the Government installation includes the time/date stamp of that installation on the bid wrapper, other documentary evidence of receipt maintained by the installation, or oral testimony or statements of Government personnel.

(d) If an emergency or unanticipated event interrupts normal Government processes so that bids cannot be received at the Government office designated for receipt of bids by the exact time specified in the IFB and urgent Government requirements preclude amendment of the IFB, the time specified for receipt of bids will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

(e) Bids may be withdrawn by written notice received at any time before the exact time set for receipt of bids. If the IFB authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids, subject to the conditions specified in the provision at 52.214-31, Facsimile Bids. A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identity of the person requesting withdrawal is established and the person signs a receipt for the bid.

(End of provision)

52.214-18 PREPARATION OF BIDS--CONSTRUCTION (APR 1984)

(a) Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a bid must initial each erasure or change appearing on any bid form.

(b) The bid form may require bidders to submit bid prices for one or more items on various bases, including--

(1) Lump sum bidding;

(2) Alternate prices;

(3) Units of construction; or

(4) Any combination of subparagraphs (1) through (3) above.

(c) If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

(d) Alternate bids will not be considered unless this solicitation authorizes their submission.

(End of provision)

52.214-19 CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION (AUG 1996)

(a) The Government will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

(b) The Government may reject any or all bids, and waive informalities or minor irregularities in bids received.

(c) The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

(d) The Government may reject a bid as nonresponsive if the prices bid are materially unbalanced between line items or subline items. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated in relation to cost for other work, and if there is a reasonable doubt that the bid will result in the lowest overall cost to the Government even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advance payment.

(End of provison)

52.214-34 SUBMISSION OF OFFERS IN THE ENGLISH LANGUAGE (APR 1991)

Offers submitted in response to this solicitation shall be in the English language. Offers received in other than English shall be rejected.

(End of provision)

52.214-35 SUBMISSION OF OFFERS IN U.S. CURRENCY (APR 1991)

Offers submitted in response to this solicitation shall be in terms of U.S. dollars. Offers received in other than U.S. dollars shall be rejected.

(End of provision)

52.214-5000 APPARENT CLERICAL MISTAKES (MAR 1995)--EFARS

(a) For the purpose of initial evaluations of bids, the following will be utilized in the resolving arithmetic discrepancies found on the face of bidding schedule as submitted by the bidder:

(1) Obviously misplaced decimal points will be corrected;
(2) Discrepancy between unit price and extended price, the unit price will govern;
(3) Apparent errors in extension of unit prices will be corrected;
(4) Apparent errors in addition of lump-sum and extended prices will be corrected.

(b) For the purpose of bid evaluation, the government will proceed on the assumption that the bidder intends his bid to be evaluated on basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

(c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

(End of statement)

52.216-1 TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a firm fixed price contract resulting from this solicitation.

(End of clause)

52.217-5 EVALUATION OF OPTIONS (JUL 1990)

(a) Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

(b) The Government may reject an offer as nonresponsive if it is materially unbalanced as to prices for the basic requirement and the option quantities. An offer is unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

(End of provision)

52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999)

(a) The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade

26.6	6.9%

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

(c) The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, within 10 working days following award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the --

(1) Name, address, and telephone number of the subcontractor;

(2) Employer's identification number of the subcontractor;

(3) Estimated dollar amount of the subcontract;

(4) Estimated starting and completion dates of the subcontract; and

(5) Geographical area in which the subcontract is to be performed.

(e) As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Ft. Story, VA
(End of provision)

52.225-12 NOTICE OF BUY AMERICAN ACT REQUIREMENT-- CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (MAY 2002)

(a) Definitions. Construction material, designated country construction material, domestic construction material, foreign construction material, and NAFTA country construction material, as used in this provision, are defined in the clause of this solicitation entitled “Buy American Act --Construction Materials under Trade Agreements” (Federal Acquisition Regulation (FAR) clause 52.225-11).

(b) Requests for determination of inapplicability. An offeror requesting a determination regarding the inapplicability of the Buy American Act should submit the request to the Contracting Officer in time to allow a determination before submission of offers. The offeror shall include the information and applicable supporting data required by paragraphs (c) and (d) of FAR clause 52.225-11 in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act before submitting its offer, or has not received a response to a previous request, the offeror shall include the information and supporting data in the offer.

(c) Evaluation of offers. (1) The Government will evaluate an offer requesting exception to the requirements of the Buy American Act, based on claimed unreasonable cost of domestic construction materials, by adding to the offered price the appropriate percentage of the cost of such foreign construction material, as specified in paragraph (b)(4)(i) of FAR clause 52.225-11.

(2) If evaluation results in a tie between an offeror that requested the substitution of foreign construction material based on unreasonable cost and an offeror that did not request an exception, the Contracting Officer will award to the offeror that did not request an exception based on unreasonable cost.

(d) Alternate offers. (1) When an offer includes foreign construction material, other than designated country or NAFTA country construction material, that is not listed by the Government in this solicitation in paragraph (b)(3) of FAR clause 52.225-11, the offeror also may submit an alternate offer based on use of equivalent domestic, designated country, or NAFTA country construction material.

(2) If an alternate offer is submitted, the offeror shall submit a separate Standard Form 1442 for the alternate offer, and a separate price comparison table prepared in accordance with paragraphs (c) and (d) of FAR clause 52.225-11 for the offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception applies.

(3) If the Government determines that a particular exception requested in accordance with paragraph (c) of FAR clause 52.225-11 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic, designated country, or NAFTA country construction material, and the offeror shall be required to furnish such domestic, designated country, or NAFTA country construction material. An offer based on use of the foreign construction material for which an exception was requested--

(i) Will be rejected as nonresponsive if this acquisition is conducted by sealed bidding; or

(ii) May be accepted if revised during negotiations.

(End of provision)

52.228-1 BID GUARANTEE (SEP 1996)

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, e.g., bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.-

(c) The amount of the bid guarantee shall be 20 % percent of the bid price or $ 3,000,000, whichever is less.-

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.-

(e) In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(End of clause)

52.233-2 SERVICE OF PROTEST (AUG 1996)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from

(b) Mark R. Yates
U.S. Army Corps of Engineers
600 Dr. Martin Luther King, Jr. Place
Room 821
Louisville, KY 40202-2230

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

LCL 0000-002 REQUESTS FOR INFORMATION.

Inquiries relating to this procurement should be directed to the Louisville District, Corps of Engineers, as listed below: Oral explanations or instructions given before the award of a contract will not be binding.

Contracting POC: Sharon Evans
Phone Number: (502) 315-6187
Fax Number: (502) 315-6194
Email: sharon.k.evans@lrl02.usace.army.mil

Prospective Bidders/Offerors may find the plan holders list on the Internet at
http://www.lrl.usace.army.mil/ebs/
NOTE: All contractors must register on web to receive copies of the solicitation or to receive notices that amendments are available for download.

LCL 0000-003 BIDDER'S QUALIFICATIONS

Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work. The successful bidders will be required to submit his Workman's Compensation Experience Modification Rate (EMR) for the previous 3 years.

LCL 0000-006 MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS OR OFFERS

The right is reserved, as the interest of the Government may require, to revise or amend the specifications and/or drawings prior to the date set for opening of bids or date of proposal closing. Such revisions and amendments, if any, will be announced by an amendment or amendments to this solicitation. Copies of such amendments as may be issued will be furnished to all prospective bidders/offerors. If the revisions and amendments are of a nature which require material changes in quantities or prices bid/offered or both, the date set for opening bids or closing of proposals may be postponed by such number of days as in the opinion of the Contracting Officer will enable bidders/offers to revise their submittal. In such cases, the amendment will include an announcement of the new date for opening bids or closing of proposals.

LCL 0000-009 FIELD OFFICE OVERHEAD

FIELD OFFICE OVERHEAD PER DIEM RATE

If any change to the contract, issued pursuant to the CHANGES clause or otherwise, for which the Government is responsible, causes an increase or decrease in the Contractor's cost of, or the time required for, performance under the contract, the Contracting Officer shall make an equitable adjustment and modify the contract in writing.

Under such equitable adjustment, no payment of field office overhead shall be allowed for any changes when completion of the contract is not extended by reason of the change, except the Contractor may be reimbursed any variable expense it incurs due to the change, provided it can substantiate the variables. The Contractor shall be reimbursed for field office overhead on a per diem basis when the completion of the contract is extended by reason of the change issued under any clause except the DEFAULT clause. Equitable adjustment shall be made for the costs that are incurred or are to be incurred due to the change. The Contractor shall provide a detailed breakdown of its proposed increase or decrease of costs as required by Contract Clause DFARS 252.236-7001 MODIFICATION OF PROPOSALS – PRICE BREAKDOWN.

FIELD OFFICE OVERHEAD PERCENTAGE MARKUP

If any change to the contract issued pursuant to the CHANGES clause or otherwise, for which the Government is responsible, causes an increase or decrease in the Contractor's cost of, or the time required for, performance under the contract, the Contracting Officer shall make an equitable adjustment and modify the contract in writing.

Under such equitable adjustment, no per diem rate for field office overhead shall be allowed if the Contractor has elected a percentage markup in keeping with its standard accounting practices. In such a case, payment of field office overhead shall be allowed for any change on a percentage markup basis regardless of whether the completion of the contract is or is not extended by reason of the change, except for modifications, issued pursuant to the DEFAULT clause. The Contractor shall provide a detailed breakdown of its proposed increase or decrease of costs as required by contract clause DFARS 252.236-7001 MODIFICATION OF PROPOSALS – PRICE BREAKDOWN.

LCL 0009-001 SPECIAL STANDARDS

In accordance with FAR 9.104-2, within five (5) working days after bid opening, and prior to award of contract, the apparent low bidder shall submit to the Contracting Officer for review and approval the information required after SECTION 01331 of the specifications.

LCL 0214-003 AWARD TO SINGLE BIDDER/OFFEROR.

Subject to the provisions contained herein, award will be made to a single bidder/offeror. Bids/offers must include unit prices for each item listed in order that bids may be properly evaluated. Failure to do this will be cause for rejection of the entire bid/offer. Bids will be evaluated on the basis of the estimated quantities shown, and award shall be made to that responsible bidder/offeror whose total aggregate price is low, subject to the requirements of the paragraph entitled, ADDITIVE OR DEDUCTIVE ITEMS, DFARS 252.236-7007, if applicable.

LCL 0214-005 SUPPLEMENT TO SUBMISSION OF BIDS, FAR 52.214-5

Hand-carried bids shall be deposited in the depository located in Room 821, Mazzoli Federal Building,, 600 Dr. Martin Luther King, Jr., Place, Louisville, Kentucky 40202.

Express mail bids shall be addressed as shown in above paragraph, ATTN: CELRLCT/Hitner

LCL 0219-001 SUBCONTRACTING PLANS FOR SMALL BUSINESS CONCERNS

Bidders are cautioned that compliance with CONTRACT CLAUSE: SMALL BUSINESS SUBCONTRACTING PLAN requires that the apparent low bidder, upon request by the Contracting Officer, submit a subcontracting plan. Bidders desiring assistance in developing a source list are encouraged to contact small business, HUBZone small business, small disadvantaged, and women-owned small business associations and appropriate Offices of Small and Disadvantaged Business Utilization, addresses which may be obtained from the District Labor Adviser, U.S. Army Engineer District, P.O. Box 59, Louisville, Kentucky 40201 (Telephone 502/315-6651).

LCL 0228-001 RULES FOR USE OF INDIVIDUAL SURETIES.

(a) One individual surety is adequate support for a bond, provided the unencumbered value of the assets pledged by that individual surety equal or exceed the amount of the bond. An offeror may submit up to three individual sureties for each bond, in which case the pledged assets when combined must equal or exceed the penal amount of the bond. Each individual surety must accept both joint and several liability to the extent of the penal amount of the bond.

(b) An individual surety may be accepted only if a security interest in acceptable assets is provided to the Government by the individual surety. The security interest shall be furnished with the bond, and may be provided by one or a combination of the following methods:

(1) An escrow account with a federally insured financial institution in the name of the contracting agency.

(2) A lien on real property, subject to restrictions contained herein.

(c) Acceptable assets include:

(1) Cash or certificates of deposit, or other cash equivalents with a federally insured financial institution;

(2) United States Government securities at market value;

(3) Stocks and bonds actively traded on a national U.S. security exchange with certificates issued in the name of the individual surety (these assets will be accepted at 90 percent of their 52 week low, as reflected at the time of submission of the bond);

(4) Real property owned in fee simple by the surety without any form of concurrent ownership (these assets will be accepted at 100 percent of the most current tax assessment value exclusive of encumbrances or 75 percent of the properties' unencumbered market value provided a current appraisal is furnished);

(5) Irrevocable letters of credit (ILC) issued by a federally insured financial institution in the name of the contracting agency and which identify the agency and solicitation or contract number for which the ILC is provided.

(d) Unacceptable assets include but are not limited to:

(1) Notes or accounts receivable;

(2) Foreign securities;

(3) Real property as follows:

a. Real property located outside the United States, its territories, or possessions.

b. Real property which is a principal residence of the surety.

c. Real property owned concurrently regardless of the form of co-tenancy except where all co-tenants agree to act jointly.

d. Life estates, leasehold estates, or future interests in real property.

(4) Personal property such as jewelry, furs, antiques;

(5) Stocks and bonds of the individual surety in a controlled, affiliated, or closely held concern of the Offeror/Contractor;

(6) Corporate assets (e.g., plant and equipment);

(7) Speculative assets (e.g., mineral rights);

(8) Letters of credit, except as provided in subparagraph c(5) above.

(e) With respect to the acceptance of real property, the individual surety shall provide:

(1) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice;

(2) Evidence of the amount due under any encumbrance shown in the evidence of title;

(3) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has

been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice.

(4) Failure to provide evidence that the lien has been properly recorded will render the offeror nonresponsible.

(f) An individual may be excluded from acting as individual surety on bonds for any of the following causes:

(1) Failure to fulfill the obligations under any bond.

(2) Failure to disclose all bond obligations.

(3) Misrepresentation of the value of available assets or outstanding liabilities.

(4) Any false or misleading statement, signature or representation on a bond or affidavit of individual suretyship.

(5) Any other cause affecting responsibility as a surety of such serious and compelling nature as may be determined to warrant exclusion.

An individual surety excluded pursuant to this subsection shall be included on the list entitled "Parties Excluded from Procurement Programs."

(g) Any bidder or offeror should carefully review these requirements which are set forth in Section 28 of the Federal Acquisition Regulations (FAR).

LCL 0228-005 SUPPLEMENT TO BID GUARANTEE

The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents. Bid bonds are not required for projects under $100,000.

LCL 0228-006 PERFORMANCE AND PAYMENT BONDS SUPPLEMENTAL

After the prescribed forms are presented to the bidder to whom award is made for signature, a written contract on the form prescribed by the specifications shall be executed and two bonds, each with good and sufficient surety or sureties acceptable to the Government shall be furnished: a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A). The penal sums of such bonds will be as follows:

(a) For both Performance Bond and Payment Bond:. The penal amount of each bond shall equal one hundred percent (100%) of the original contract price.

(b) If the contract price increases, an additional amount equal to 100 percent of the increase.

(c) The amount of the payment bond must be no less than the amount of the performance bond.

(d) See also the RULES FOR USE OF INDIVIDUAL SURETIES.

(e) Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of contract performance.

LCL 0228-007 PAYMENT FOR BOND PREMIUMS.

CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS provides that upon presentation of evidence of full payment, the Government will immediately reimburse the Contractor the cost of premiums for performance and payment bonds. This reimbursement amount is not in addition to the amount bid for the work covered by this Invitation for Bids, and bidders are cautioned to include the cost of such premiums in the bid items shown on the Bidding Schedule (or in the lump sum amount of the bid if no bid items are listed). If bond premiums are reimbursed under this clause, such reimbursed amount will be recovered by the Government from the progress payments made to the Contractor or, if no progress payments are made, from the amount otherwise due the Contractor upon final payment.

LCL 0236-002 RESTRICTIVE LIMITATION

Except for Additives and Options, the Government shall accept all items listed in SECTION 00010 of this solicitation.

Section 00600 - Representations & Certifications

INTRO

COMPANY NAME AND ADDRESS: _____
_____
_____

PHONE NUMBER _____ FAX NUMBER _____

EMAIL ADDRESS_____

BUSINESS SIZE (select one)

Large Business _____ Small Business_____ HUBZone Business_____

Contractor is registered with Central Contractor Registration: _____ YES _____ NO
(See DFARS 252.204-7004)

INDICATE DUNS NUMBER _____ CAGE NO. _____
(Note: See FAR 52.204-6. The DUNS Number is a 9 digit numeric code.) (See FAR 52.204-7001)

CLAUSES INCORPORATED BY FULL TEXT

52.203-2 CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985)

(a) The offeror certifies that --

(c) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to –

(1) Those prices,

(i) The intention to submit an offer, or

(iii) The methods of factors used to calculate the prices offered:

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory --

(1) Is the person in the offeror's organization responsible for determining the prices offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provison _____ (insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization);

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision.

(c) If the offeror deletes or modifies subparagraph (a)(2) of this provision, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of clause)

52.203-3 GRATUITIES (APR 1984)

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to an officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) of this clause, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c)(2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-11 CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991)

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of

this Certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989,--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of $100,000 shall certify and disclose accordingly.

(d) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision, shall be subject to a civil penalty of not less than $10,000, and not more than $100,000, for each such failure.

(End of provision)

52.204-3 TAXPAYER IDENTIFICATION (OCT 1998)

(a) Definitions.

“Common parent,” as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

“Taxpayer Identification Number (TIN),” as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(d) Taxpayer Identification Number (TIN).

___ TIN:._____

___ TIN has been applied for.

___ TIN is not required because:

___ Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

___ Offeror is an agency or instrumentality of a foreign government;

___ Offeror is an agency or instrumentality of the Federal Government.

(e) Type of organization.

___ Sole proprietorship;

___ Partnership;

___ Corporate entity (not tax-exempt);

___ Corporate entity (tax-exempt);

___ Government entity (Federal, State, or local);

___ Foreign government;

___ International organization per 26 CFR 1.6049-4;

___ Other _____

(f) Common parent.

___ Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

___ Name and TIN of common parent:

Name _____

TIN _____

(End of provision)

52.204-5 WOMEN-OWNED BUSINESS (OTHER THAN SMALL BUSINESS) (MAY 1999)

(a) Definition. Women-owned business concern, as used in this provision, means a concern that is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of its stock is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(b) Representation. [Complete only if the offeror is a women-owned business concern and has not represented itself as a small business concern in paragraph (b)(1) of FAR 52.219-1, Small Business Program Representations, of this solicitation.] The offeror represents that it ( ) is a women-owned business concern.

(End of provision)

52.209-5 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (DEC 2001)

(a)(1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals --

(A) Are ( ) are not ( ) presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have ( ) have not ( ), within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are ( ) are not ( ) presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has ( ) has not ( ), within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was

placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

52.209-6 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (JUL 1995)

(a) The Government suspends or debars Contractors to protect the Government's interests. The Contractor shall not enter into any subcontract in excess of the $25,000 with a Contractor that is debarred, suspended, or proposed for debarment unless there is a compelling reason to do so.

(b) The Contractor shall require each proposed first-tier subcontractor, whose subcontract will exceed $25,000, to disclose to the Contractor, in writing, whether as of the time of award of the subcontract, the subcontractor, or its principles, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(c) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs). The notice must include the following:

(1) The name of the subcontractor.

(2) The Contractor's knowledge of the reasons for the subcontractor being on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(3) The compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(End of clause)

52.219-1 SMALL BUSINESS PROGRAM REPRESENTATIONS (APR 2002) - ALTERNATE I (APR 2002)

(a)(1) The North American Industry Classification System (NAICS) code for this acquisition is 236220.

(2) The small business size standard is $28.5 million.

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) Representations. (1) The offeror represents as part of its offer that it ( ) is, ( ) is not a small business concern.

(2) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents, for general statistical purposes, that it ( ) is, ( ) is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it ( ) is, ( ) is not a women-owned small business concern.

(4) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it ( ) is, ( ) is not a veteran-owned small business concern.

(5) (Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (b)(4) of this provision.) The offeror represents as part of its offer that it ( ) is, ( ) is not a service-disabled veteran-owned small business concern.

(6) [Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.] The offeror represents, as part of its offer, that--

(i) It ( ) is, ( ) is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material change in ownership and control, principal office, or HUBZone employee percentage has occurred since it was certified by the Small Business Administration in accordance with 13 CFR part 126; and

(ii) It ( ) is, ( ) is not a joint venture that complies with the requirements of 13 CFR part 126, and the representation in paragraph (b)(6)(i) of this provision is accurate for the HUBZone small business concern or concerns that are participating in the joint venture. (The offeror shall enter the name or names of the HUBZone small business concern or concerns that are participating in the joint venture:_____.) Each HUBZone small business concern participating in the joint venture shall submit a separate signed copy of the HUBZone representation.

(7) (Complete if offeror represented itself as disadvantaged in paragraph (b)(2) of this provision.) The offeror shall check the category in which its ownership falls:

____ Black American.

____ Hispanic American.

____ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

____ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

____ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

____ Individual/concern, other than one of the preceding.

(c) Definitions. As used in this provision--

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

"Small business concern," means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

"Women-owned small business concern," means a small business concern --

(1) That is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; or

(2) Whose management and daily business operations are controlled by one or more women.

(d) Notice.

(1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small, HUBZone small, small disadvantaged, or women-owned small business concern in order to obtain a contract to be awarded under the preference programs established pursuant to section 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

(i) Be punished by imposition of fine, imprisonment, or both;

(ii) Be subject to administrative remedies, including suspension and debarment; and

(iii) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

52.219-2 EQUAL LOW BIDS. (OCT 1995)

(a) This provision applies to small business concerns only.

(b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

_____
_____

(c) Failure to identify the labor surplus area as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

52.219-19 SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (OCT 2000)

(a) Definition.

"Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the North American Industry Classification System (NAICS) code assigned to a contracting opportunity.

(b) [Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.] The Offeror [ ] is, [ ] is not an emerging small business.

(c) (Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)

Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts). (Check one of the following.)

No. of Employees	Avg. Annual Gross Revenues
____ 50 or fewer	____ $1 million or less
____ 51 - 100	____ $1,000,001 - $2 million
____ 101 - 250	____ $2,000,001 - $3.5 million
____ 251 - 500	____ $3,500,001 - $5 million
____ 501 - 750	____ $5,000,001 - $10 million
____ 751 - 1,000	____ $10,000,001 - $17 million
____ Over 1,000	____ Over $17 million

(End of provision)

52.222-22 PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999)

The offeror represents that --

(a) ( ) It has, ( ) has not participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation;

(b) ( ) It has, ( ) has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of provision)

52.222-25 AFFIRMATIVE ACTION COMPLIANCE (APR 1984)

The offeror represents that

(a) [ ] it has developed and has on file, [ ] has not developed and does not have on file, at each establishment, affirmative action programs required by the rules and regulations of the Secretary of Labor (41 CFR 60-1 and 60-2), or

(b) [ ] has not previously had contracts subject to the written affirmative action programs requirement of the rules and regulations of the Secretary of Labor.

(End of provision)

52.222-38 COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (DEC 2001)

By submission of its offer, the offeror represents that, if it is subject to the reporting requirements of 38 U.S.C. 4212(d) (i.e., if it has any contract containing Federal Acquisition Regulation clause 52.222-37, Employment Reports on Special Disabled Veterans, Veterans of the Vietnam Era, and Other Eligible Veterans), it has submitted the most recent VETS-100 Report required by that clause.

(End of provision)

52.223-13 CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8, 1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C.

13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facility is exempt for at least one of the following reasons: (Check each block that is applicable.)

( ) (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

( ) (ii) The facility does not have 10 or more full-time employees as specified in section 313.(b)(1)(A) of EPCRA 42 U.S.C. 11023(b)(1)(A);

( ) (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

( ) (iv) The facility does not fall within Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

( ) (v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of clause)

252.209-7001 DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) "Definitions."

As used in this provision --

(a) "Government of a terrorist country" includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) "Terrorist country" means a country determined by the Secretary of State, under section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405(j)(i)(A)), to be a country the government of which has repeatedly provided support for such acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) "Significant interest" means --

(i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;

(ii) Holding a management position in the firm, such as a director or officer;

(iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;

(iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible

assets of the firm; or

(v) Holding 50 percent or more of the indebtness of a firm.

(b) "Prohibition on award."

In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary or, in the case of a subsidiary, the firm that owns the subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) "Disclosure."

If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclosure such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include --

(1) Identification of each government holding a significant interest; and

(2) A description of the significant interest held by each government.

(End of provision)

252.225-7031 SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992)

(a) Definitions. As used in this clause--

(1) "Foreign person" means any person other than a United States person as defined in Section 16(2) of the Export Administration Act of 1979 (50 U.S.C. App. Sec 2415).

(2) "United States person" is defined in Section 16(2) of the Export Administration Act of 1979 and means any United States resident or national (other than an individual resident outside the United States and employed by other than a United States person), any domestic concern (including any permanent domestic establishment of any foreign concern), and any foreign subsidiary or affiliate (including any permanent foreign establishment) of any domestic concern which is controlled in fact by such domestic concerns, as determined under regulations of the President.

(b) Certification. By submitting this offer, the Offeror, if a foreign person, company or entity, certifies that it--

(1) Does not comply with the Secondary Arab Boycott of Israel; and

(2) Is not taking or knowingly agreeing to take any action, with respect to the Secondary Boycott of Israel by Arab countries, which 50 U.S.C. App. Sec 2407(a) prohibits a United States person from taking.

(End of clause)

Section 00700 - Contract Clauses

CLAUSES INCORPORATED BY FULL TEXT

52.202-1 DEFINITIONS (MAY 2001) --ALTERNATE I (MAR 2001)

(a) Agency head or head of the agency means the Secretary (Attorney General, Administrator, Governor, Chairperson, or other chief official, as appropriate) of the agency, unless otherwise indicated, including any deputy or assistant chief official of the executive agency.

(b) Commercial component means any component that is a commercial item.

(c) Component means any item supplied to the Government as part of an end item or of another component, except that for use in 52.225-9, and 52.225-11 see the definitions in 52.225-9(a) and 52.225-11(a).

(d) Contracting Officer means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(e) Nondevelopmental item means--

(1) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;

(2) Any item described in paragraph (f)(1) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or

(3) Any item of supply being produced that does not meet the requirements of paragraph (f)(1) or (f)(2) solely because the item is not yet in use.

(f) "Contracting Officer" means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(g) Except as otherwise provided in this contract, the term "subcontracts" includes, but is not limited to, purchase orders and changes and modifications to purchase orders under this contract.

(End of clause)

52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or, in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit

or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

(End of clause)

52.203-7 ANTI-KICKBACK PROCEDURES. (JUL 1995)

(a) Definitions.

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided, directly or indirectly, to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract.

"Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment, or services of any kind.

"Prime Contractor," as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) The Anti-Kickback Act of 1986 (41 U.S.C. 51-58) (the Act), prohibits any person from -

(1) Providing or attempting to provide or offering to provide any kickback;

(2) Soliciting, accepting, or attempting to accept any kickback; or

(3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c)(1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Department of Justice.

(3) The Contractor shall cooperate fully with any Federal agency investigating a possible violation described in paragraph (b) of this clause.

(4) The Contracting Officer may (i) offset the amount of the kickback against any monies owed by the United States under the prime contract and/or (ii) direct that the Prime Contractor withhold, from sums owed a subcontractor under the prime contract, the amount of any kickback. The Contracting Officer may order the monies withheld under subdivision (c)(4)(ii) of this clause be paid over to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the Prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including this subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract which exceed $100,000.

52.203-8 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(a) If the Government receives information that a contractor or a person has engaged in conduct constituting a violation of subsection (a), (b), (c), or (d) of Section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423) (the Act), as amended by section 4304 of the 1996 National Defense Authorization Act for Fiscal Year 1996 (Pub. L. 104-106), the Government may--

(1) Cancel the solicitation, if the contract has not yet been awarded or issued; or

(2) Rescind the contract with respect to which--

(i) The Contractor or someone acting for the Contractor has been convicted for an offense where the conduct constitutes a violation of subsection 27(a) or (b) of the Act for the purpose of either--

(A) Exchanging the information covered by such subsections for anything of value; or

(B) Obtaining or giving anyone a competitive advantage in the award of a Federal agency procurement contract; or

(ii) The head of the contracting activity has determined, based upon a preponderance of the evidence, that the

Contractor or someone acting for the Contractor has engaged in conduct constituting an offense punishable under subsections 27(e)(1) of the Act.

(b) If the Government rescinds the contract under paragraph (a) of this clause, the Government is entitled to recover, in addition to any penalty prescribed by law, the amount expended under the contract.

(c) The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law, regulation, or under this contract.

(End of clause)

52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(a) The Government, at its election, may reduce the price of a fixed-price type contract and the total cost and fee under a cost-type contract by the amount of profit or fee determined as set forth in paragraph (b) of this clause if the head of the contracting activity or designee determines that there was a violation of subsection 27 (a), (b), or (c) of the Office of Federal Procurement Policy Act, as amended (41 U.S.C. 423), as implemented in section 3.104 of the Federal Acquisition Regulation.

(b) The price or fee reduction referred to in paragraph (a) of this clause shall be--

(1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;

(2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award, notwithstanding any minimum fee or "fee floor" specified in the contract;

(3) For cost-plus-award-fee contracts--

(i) The base fee established in the contract at the time of contract award;

(ii) If no base fee is specified in the contract, 30 percent of the amount of each award fee otherwise payable to the Contractor for each award fee evaluation period or at each award fee determination point.

(4) For fixed-price-incentive contracts, the Government may--

(i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award; or

(ii) If an immediate adjustment to the contract target price and contract target profit would have a significant adverse impact on the incentive price revision relationship under the contract, or adversely affect the contract financing provisions, the Contracting Officer may defer such adjustment until establishment of the total final price of the contract. The total final price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price.

(5) For firm-fixed-price contracts, by 10 percent of the initial contract price or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award.

(c) The Government may, at its election, reduce a prime contractor's price or fee in accordance with the procedures of paragraph (b) of this clause for violations of the Act by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(d) In addition to the remedies in paragraphs (a) and (c) of this clause, the Government may terminate this contract for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997)

(a) Definitions.

"Agency," as used in this clause, means executive agency as defined in 2.101.

"Covered Federal action," as used in this clause, means any of the following Federal actions:

(1) The awarding of any Federal contract.

(2) The making of any Federal grant.

(3) The making of any Federal loan.

(4) The entering into of any cooperative agreement.

(5) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

"Indian tribe" and "tribal organization," as used in this clause, have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and include Alaskan Natives.

"Influencing or attempting to influence," as used in this clause, means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government," as used in this clause, means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Officer or employee of an agency," as used in this clause, includes the following individuals who are employed by an agency:

(1) An individual who is appointed to a position in the Government under Title 5, United States Code, including a position under a temporary appointment.

(2) A member of the uniformed services, as defined in subsection 101(3),Title 37, United States Code.

(3) A special Government employee, as defined in section 202, Title 18, United States Code.

(4) An individual who is a member of a Federal advisory committee, as defined by the Federal Advisory Committee Act, Title 5, United States Code, appendix 2.

"Person," as used in this clause, means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit, or not for profit. This

term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation," as used in this clause, means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment," as used in this clause, means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient," as used in this clause, includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Regularly employed," as used in this clause, means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

"State," as used in this clause, means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, a territory or possession of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

(b) Prohibitions.

(1) Section 1352 of Title 31, United States Code, among other things, prohibits a recipient of a Federal contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan, or cooperative agreement.

(2) The Act also requires Contractors to furnish a disclosure if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

(3) The prohibitions of the Act do not apply under the following conditions:

(i) Agency and legislative liaison by own employees.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of a payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action if the payment is for agency and legislative liaison activities not directly related to a covered Federal action.

(B) For purposes of subdivision (b)(3)(i)(A) of this clause, providing any information specifically requested by an agency or Congress is permitted at any time.

(C) The following agency and legislative liaison activities are permitted at any time where they are not related to a specific solicitation for any covered Federal action:

(1) Discussing with an agency the qualities and characteristics (including individual demonstrations) of the person's products or services, conditions or terms of sale, and service capabilities.

(2) Technical discussions and other activities regarding the application or adaptation of the person's products or services for an agency's use.

(D) The following agency and legislative liaison activities are permitted where they are prior to formal solicitation of any covered Federal action--

(1) Providing any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

(2) Technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

(3) Capability presentations by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Pub. L. 95-507, and subsequent amendments.

(E) Only those services expressly authorized by subdivision (b)(3)(i)(A) of this clause are permitted under this clause.

(ii) Professional and technical services.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of--

(1) A payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

(2) Any reasonable payment to a person, other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.

(B) For purposes of subdivision (b)(3)(ii)(A) of this clause, "professional and technical services" shall be limited to advice and analysis directly applying any professional or technical discipline. For example, drafting of a legal document accompanying a bid or proposal by a lawyer is allowable. Similarly, technical advice provided by an engineer on the performance or operational capability of a piece of equipment rendered directly in the negotiation of a contract is allowable. However, communications with the intent to influence made by a professional (such as a licensed lawyer) or a technical person (such as a licensed accountant) are not allowable under this section unless they provide advice and analysis directly applying their professional or technical expertise and unless the advice or analysis is rendered directly and solely in the preparation, submission or negotiation of a covered Federal action. Thus, for example, communications with the intent to influence made by a lawyer that do not provide legal advice or analysis directly and solely related to the legal aspects of his or her client's proposal, but generally advocate one proposal over another are not allowable under this section because the lawyer is not providing professional legal services. Similarly, communications with the intent to influence made by an engineer providing an engineering analysis prior to the preparation or submission of a bid or proposal are not allowable under this section since the

engineer is providing technical services but not directly in the preparation, submission or negotiation of a covered Federal action.

(C) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation and any other requirements in the actual award documents.

(D) Only those services expressly authorized by subdivisions (b)(3)(ii)(A)(1) and (2) of this clause are permitted under this clause.

(E) The reporting requirements of FAR 3.803(a) shall not apply with respect to payments of reasonable compensation made to regularly employed officers or employees of a person.

(c) Disclosure.

(1) The Contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using nonappropriated funds (to include profits from any covered Federal action), which would be prohibited under subparagraph (b)(1) of this clause, if paid for with appropriated funds.

(2) The Contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously filed by such person under subparagraph (c)(1) of this clause. An event that materially affects the accuracy of the information reported includes--

(i) A cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or

(ii) A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or

(iii) A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.

(3) The Contractor shall require the submittal of a certification, and if required, a disclosure form by any person who requests or receives any subcontract exceeding $100,000 under the Federal contract.

(4) All subcontractor disclosure forms (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall submit all disclosures to the Contracting Officer at the end of the calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(d) Agreement. The Contractor agrees not to make any payment prohibited by this clause.

(e) Penalties.

(1) Any person who makes an expenditure prohibited under paragraph (a) of this clause or who fails to file or amend the disclosure form to be filed or amended by paragraph (b) of this clause shall be subject to civil penalties as provided for by 31 U.S.C. 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(2) Contractors may rely without liability on the representation made by their subcontractors in the certification and disclosure form.

(f) Cost allowability. Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

(End of clause)

52.204-4 PRINTED OR COPIED DOUBLE-SIDED ON RECYCLED PAPER (AUG 2000)

(a) Definitions. As used in this clause--

“Postconsumer material” means a material or finished product that has served its intended use and has been discarded for disposal or recovery, having completed its life as a consumer item. Postconsumer material is a part of the broader category of “recovered material.” For paper and paper products, postconsumer material means “postconsumer fiber” defined by the U.S. Environmental Protection Agency (EPA) as--

(1) Paper, paperboard, and fibrous materials from retail stores, office buildings, homes, and so forth, after they have passed through their end-usage as a consumer item, including: used corrugated boxes; old newspapers; old magazines; mixed waste paper; tabulating cards; and used cordage; or

(2) All paper, paperboard, and fibrous materials that enter and are collected from municipal solid waste; but not

(3) Fiber derived from printers' over-runs, converters' scrap, and over-issue publications.

“Printed or copied double-sided” means printing or reproducing a document so that information is on both sides of a sheet of paper.

“Recovered material,” for paper and paper products, is defined by EPA in its Comprehensive Procurement Guideline as “recovered fiber” and means the following materials:

(1) Postconsumer fiber; and

(2) Manufacturing wastes such as--

(i) Dry paper and paperboard waste generated after completion of the papermaking process (that is, those manufacturing operations up to and including the cutting and trimming of the paper machine reel into smaller rolls or rough sheets) including: envelope cuttings, bindery trimmings, and other paper and paperboard waste resulting from printing, cutting, forming, and other converting operations; bag, box, and carton manufacturing wastes; and butt rolls, mill wrappers, and rejected unused stock; and

(ii) Repulped finished paper and paperboard from obsolete inventories of paper and paperboard manufacturers, merchants, wholesalers, dealers, printers, converters, or others.

(b) In accordance with Section 101 of Executive Order 13101 of September 14, 1998, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, the Contractor is encouraged to submit paper documents, such as offers, letters, or reports, that are printed or copied double-sided on recycled paper that meet minimum content standards specified in Section 505 of Executive Order 13101, when not using electronic commerce methods to submit information or data to the Government.

(c) If the Contractor cannot purchase high-speed copier paper, offset paper, forms bond, computer printout paper, carbonless paper, file folders, white wove envelopes, writing and office paper, book paper, cotton fiber paper, and cover stock meeting the 30 percent postconsumer material standard for use in submitting paper documents to the Govemment, it should use paper containing no less than 20 percent postconsumer material. This lesser standard

should be used only when paper meeting the 30 percent postconsumer material standard is not obtainable at a reasonable price or does not meet reasonable performance standards.

(End of clause)

52.214-26 AUDIT AND RECORDS--SEALED BIDDING. (OCT 1997)

(a) As used in this clause, records includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) Cost or pricing data. If the Contractor has been required to submit cost or pricing data in connection with the pricing of any modification to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

(1) The proposal for the modification;

(2) The discussions conducted on the proposal(s), including those related to negotiating;

(3) Pricing of the modification; or

(4) Performance of the modification.

(c) Comptroller General. In the case of pricing any modification, the Comptroller General of the United States, or an authorized representative, shall have the same rights as specified in paragraph (b) of this clause.

(d) Availability. The Contractor shall make available at its office at all reasonable times the materials described in reproduction, until 3 years after final payment under this contract, or for any other period specified in Subpart 4.7 of the Federal Acquisition Regulation (FAR). FAR Subpart 4.7, Contractor Records Retention, in effect on the data of this contract, is incorporated by reference in its entirety and made a part of this contract.

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement.

(2) Records pertaining to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to the performance of this contract shall be made available until disposition of such appeals, litigation, or claims.

(e) The Contractor shall insert a clause containing all the provisions of this clause, including this paragraph (e), in all subcontracts expected to exceed the threshold in FAR 15.403-4(a)(1) for submission of cost or pricing data.

(End of clause)

52.214-27 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA - MODIFICATIONS - SEALED BIDDING. (OCT 1997)

(a) This clause shall become operative only for any modification to this contract involving aggregate increases

and/or decreases in costs, plus applicable profits, expected to exceed the threshold for the submission of cost or pricing data at FAR 15.403-4(a)(1), except that this clause does not apply to a modification if an exception under FAR 15.403-1(b) applies.

(1) Based on adequate price competition;

(2) Based on established catalog or market prices of commercial items sold in substantial quantities to the general public; or

(3) Set by law or regulation.

(b) If any price, including profit, negotiated in connection with any modification under this clause, was increased by any significant amount because

(1) the Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data;

(2) a subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data; or

(3) any of these parties furnished data of any description that were not accurate, the price shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) above.

(c) Any reduction in the contract price under paragraph (b) above due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which:

(1) the actual subcontract; or

(2) the actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(d) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made:

(1) the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted;

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer;

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract; or

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2) Except as prohibited by subdivision (d)(2)(ii) of this clause:

(i) an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if:

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the cost or pricing data were available before the date of agreement on the price of the contract (or price of the modification) and that the data were not submitted before such date.

(ii) An offset shall not be allowed if:

(A) The understated data was known by the Contractor to be understated when the Certificate of Current Cost or Pricing Data was signed; or (B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data had been submitted before the date of agreement on price.

(e) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid:

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable underpayment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621(a)(2); and

(2) A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted cost or pricing data which were incomplete, inaccurate, or noncurrent.

(End of clause)

52.214-28 SUBCONTRACTOR COST OR PRICING DATA - MODIFICATIONS - SEALED BIDDING. (OCT 1997)

(a) The requirements of paragraphs (b) and (c) of this clause shall:

(1) become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at (FAR) 48 CFR 15.403-4(a)(1); and

(2) be limited to such modifications.

(b) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modifications involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1), the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless an exception under FAR 15.403-1(b) applies.

(1) Based on adequate price competition;

(2) Based on established catalog or market prices of commercial items sold in substantial quantities to the general public; or

(3) Set by law or regulation.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in subsection 15.406-2 of the Federal Acquisition Regulation that, to the best of its knowledge and belief, the data submitted under paragraph (b) above were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(d) The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that, when entered into, exceeds the threshold for submission of cost or pricing data at FAR 15.403-4(a)(1).

(End of clause)

52.219-4 NOTICE OF PRICE EVALUATION PREFERENCE FOR HUBZONE SMALL BUSINESS CONCERNS (JAN 1999)

(a) Definition. HUBZone small business concern, as used in this clause, means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

(b) Evaluation preference. (1) Offers will be evaluated by adding a factor of 10 percent to the price of all offers, except--

(i) Offers from HUBZone small business concerns that have not waived the evaluation preference;

(ii) Otherwise successful offers from small business concerns;

(iii) Otherwise successful offers of eligible products under the Trade Agreements Act when the dollar threshold for application of the Act is exceeded (see 25.402 of the Federal Acquisition Regulation (FAR)); and

(iv) Otherwise successful offers where application of the factor would be inconsistent with a Memorandum of Understanding or other international agreement with a foreign government.

(2) The factor of 10 percent shall be applied on a line item basis or to any group of items on which award may be made. Other evaluation factors described in the solicitation shall be applied before application of the factor.

(3) A concern that is both a HUBZone small business concern and a small disadvantaged business concern will receive the benefit of both the HUBZone small business price evaluation preference and the small disadvantaged business price evaluation adjustment (see FAR clause 52.219-23). Each applicable price evaluation preference or adjustment shall be calculated independently against an offeror's base offer.

These individual preference amounts shall be added together to arrive at the total evaluated price for that offer.

(c) Waiver of evaluation preference. A HUBZone small business concern may elect to waive the evaluation preference, in which case the factor will be added to its offer for evaluation purposes. The agreements in paragraph (d) of this clause do not apply if the offeror has waived the evaluation preference.

___ Offeror elects to waive the evaluation preference.

(d) Agreement. A HUBZone small business concern agrees that in the performance of the contract, in the case of a contract for

(1) Services (except construction), at least 50 percent of the cost of personnel for contract performance will be spent for employees of the concern or employees of other HUBZone small business concerns;

(2) Supplies (other than procurement from a nonmanufacturer of such supplies), at least 50 percent of the cost of manufacturing, excluding the cost of materials, will be performed by the concern or other HUBZone small business concerns;

(3) General construction, at least 15 percent of the cost of the contract performance incurred for personnel will be will be spent on the concern's employees or the employees of other HUBZone small business concerns; or

(4) Construction by special trade contractors, at least 25 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other HUBZone small business concerns.

(e) A HUBZone joint venture agrees that in the performance of the contract, the applicable percentage specified in paragraph (d) of this clause will be performed by the HUBZone small business participant or participants.

(f) A HUBZone small business concern nonmanufacturer agrees to furnish in performing this contract only end items manufactured or produced by HUBZone small business manufacturer concerns. This paragraph does not apply in connection with construction or service contracts.

(End of clause)

52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (OCT 2000)

(a) It is the policy of the United States that small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns.

(b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

Definitions. As used in this contract--

HUBZone small business concern means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

Small business concern means a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto.

Small disadvantaged business concern means a small business concern that represents, as part of its offer that--

(1) It has received certification as a small disadvantaged business concern consistent with 13 CFR part 124, subpart B;

(2) No material change in disadvantaged ownership and control has occurred since its certification;

(3) Where the concern is owned by one or more individuals, the net worth of each individual upon whom the certification is based does not exceed $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(4) It is identified, on the date of its representation, as a certified small disadvantaged business in the database maintained by the Small Business Administration (PRO-Net).

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

Women-owned small business concern means a small business concern--

(1) That is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as a small business concern, a veteran-owned small business concern, a service-disabled veteran-owned small business concern, a HUBZone small business concern, a small disadvantaged business concern, or a women-owned small business concern.

(End of clause)

52.219-9 SMALL BUSINESS SUBCONTRACTING PLAN (JAN 2002)--ALTERNATE I (OCT 2001).

(a) This clause does not apply to small business concerns.

(b) Definitions. As used in this clause--

Commercial item means a product or service that satisfies the definition of commercial item in section 2.101 of the Federal Acquisition Regulation.

Commercial plan means a subcontracting plan (including goals) that covers the offeror's fiscal year and that applies to the entire production of commercial items sold by either the entire company or a portion thereof (e.g., division, plant, or product line).

Individual contract plan means a subcontracting plan that covers the entire contract period (including option periods), applies to a specific contract, and has goals that are based on the offeror's planned subcontracting in support of the specific contract, except that indirect costs incurred for common or joint purposes may be allocated on a prorated basis to the contract.

Master plan means a subcontracting plan that contains all the required elements of an individual contract plan, except goals, and may be incorporated into individual contract plans, provided the master plan has been approved.

Subcontract means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The apparent low bidder, upon request by the Contracting Officer, shall submit a subcontracting plan, where applicable, that separately addresses subcontracting with small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns. If the bidder is submitting an individual contract plan, the plan must separately address subcontracting with small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns, with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be submitted within the time specified by the Contracting Officer. Failure to submit the subcontracting plan shall make the bidder ineligible for the award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business, veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted for an individual contract plan; or the offeror's total projected sales, expressed in dollars, and the total value of projected subcontracts to support the sales for a commercial plan;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to veteran-owned small business concerns;

(iv) Total dollars planned to be subcontracted to HUBZone small business concerns;

(v) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(vi) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to--

(i) Small business concerns;

(ii) Veteran-owned small business concerns;

(iii) HUBZone small business concerns;

(iv) Small disadvantaged business concerns; and

(v) Women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the method used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Marketing and Access Network (PRO-Net) of the Small Business Administration (SBA), veterans service organizations, the National Minority Purchasing Council Vendor Information Service, the Research and Information Division of the Minority Business Development Agency in the Department of Commerce, or small, HUBZone, small disadvantaged, and women-owned small business trade associations). A firm may rely on the information contained in PRO-Net as an accurate representation of a concern's size and ownership characteristics for the purposes of maintaining a small, veteran-owned small, HUBZone small, small disadvantaged, and women-owned small business source list. Use of PRO-Net as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, or publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror in included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with—

(i) Small business concerns;

(ii) Veteran-owned small business concerns;

(iii) HUBZone small business concerns;

(iv) Small disadvantaged business concerns; and

(v) Women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small business, veteran-owned small business, HUBZone small business, small disadvantaged business and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause of this contract entitled ``Utilization of Small Business Concerns'' in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) that receive subcontracts in excess of $500,000 ($1,000,000 for construction of any public facility) to adopt a subcontracting plan that complies with the requirements of this clause.

(10) Assurances that the offeror will--

(i) Cooperate in any studies or surveys as may be required;

(ii) Submit periodic reports so that the Government can determine the extent of compliance by the offeror with the subcontracting plan;

(iii) Submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, in accordance with paragraph (j) of this clause. The reports shall provide information on subcontract awards to small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, small disadvantaged business concerns, women-owned small business concerns, and Historically Black Colleges and Universities and Minority Institutions. Reporting shall be in accordance with the instructions on the forms or as provided in agency regulations.

(iv) Ensure that its subcontractors agree to submit SF 294 and SF 295.

(11) A description of the types of records that will be maintained concerning procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small business, veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated)

(i) Source lists (e.g., PRO-Net), guides, and other data that identify small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small business, veteran-owned small business, HUBZone small business, small disadvantaged business, or women-owned small business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than $100,000, indicating--

(A) Whether small business concerns were solicited and, if not, why not;

(B) Whether veteran-owned small business concerns were solicited and, if not, why not;

(C) Whether HUBZone small business concerns were solicited and, if not, why not;

(D) Whether small disadvantaged business concerns were solicited and, if not, why not;

(E) Whether women-owned small business concerns were solicited and, if not, why not; and

(F) If applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact--

(A) Trade associations;

(B) Business development organizations;

(C) Conferences and trade fairs to locate small, HUBZone small, small disadvantaged, and women-owned small business sources; and

(D) Veterans service organizations.

(v) Records of internal guidance and encouragement provided to buyers through--

(A) Workshops, seminars, training, etc.; and

(B) Monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having commercial plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.

(2) Provide adequate and timely consideration of the potentialities of small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns in all ``make-or-buy'' decisions.

(3) Counsel and discuss subcontracting opportunities with representatives of small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business firms.

(4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, veteran-owner small business, HUBZone small, small disadvantaged, or women-owned small business for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master plan on a plant or division-wide basis that contains all the elements required by paragraph (d) of this clause, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided--
(1) the master plan has been approved, (2) the offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer, and (3) goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) A commercial plan is the preferred type of subcontracting plan for contractors furnishing commercial items. The commercial plan shall relate to the offeror's planned subcontracting generally, for both commercial and Government business, rather than solely to the Government contract. Commercial plans are also preferred for subcontractors that provide commercial items under a prime contract, whether or not the prime contractor is supplying a commercial item.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization Of Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(j) The Contractor shall submit the following reports:

(1) Standard Form 294, Subcontracting Report for Individual Contracts. This report shall be submitted to the Contracting Officer semiannually and at contract completion. The report covers subcontract award data related to this contract. This report is not required for commercial plans.

(2) Standard Form 295, Summary Subcontract Report. This report encompasses all of the contracts with the awarding agency. It must be submitted semi-annually for contracts with the Department of Defense and annually for contracts with civilian agencies. If the reporting activity is covered by a commercial plan, the reporting activity must report annually all subcontract awards under that plan. All reports submitted at the close of each fiscal year (both individual and commercial plans) shall include a breakout, in the Contractor's format, of subcontract awards, in whole dollars, to small disadvantaged business concerns by North American Industry Classification System (NAICS) Industry Subsector. For a commercial plan, the Contractor may obtain from each of its subcontractors a predominant NAICS Industry Subsector and report all awards to that subcontractor under its predominant NAICS Industry Subsector.

(End of clause)

52.219-16 LIQUIDATED DAMAGES-SUBCONTRACTING PLAN (JAN 1999)

(a) Failure to make a good faith effort to comply with the subcontracting plan, as used in this clause, means a willful or intentional failure to perform in accordance with the requirements of the subcontracting plan approved under the clause in this contract entitled "Small Business Subcontracting Plan," or willful or intentional action to frustrate the plan.

(b) Performance shall be measured by applying the percentage goals to the total actual subcontracting dollars or, if a commercial plan is involved, to the pro rata share of actual subcontracting dollars attributable to Government contracts covered by the commercial plan. If, at contract completion or, in the case of a commercial plan, at the close of the fiscal year for which the plan is applicable, the Contractor has failed to meet its subcontracting goals and the Contracting Officer decides in accordance with paragraph (c) of this clause that the Contractor failed to make a good faith effort to comply with its subcontracting plan, established in accordance with the clause in this contract entitled “Small Business Subcontracting Plan,” the Contractor shall pay the Government liquidated damages in an amount stated. The amount of probable damages attributable to the Contractor's failure to comply shall be an amount equal to the actual dollar amount by which the Contractor failed to achieve each subcontract goal.

(c) Before the Contracting Officer makes a final decision that the Contractor has failed to make such good faith effort, the Contracting Officer shall give the Contractor written notice specifying the failure and permitting the Contractor to demonstrate what good faith efforts have been made and to discuss the matter. Failure to respond to the notice may be taken as an admission that no valid explanation exists. If, after consideration of all the pertinent data, the Contracting Officer finds that the Contractor failed to make a good faith effort to comply with the subcontracting plan, the Contracting Officer shall issue a final decision to that effect and require that the Contractor pay the Government liquidated damages as provided in paragraph (b) of this clause.

(d) With respect to commercial plans, the Contracting Officer who approved the plan will perform the functions of the Contracting Officer under this clause on behalf of all agencies with contracts covered by the commercial plan.

(e) The Contractor shall have the right of appeal, under the clause in this contract entitled Disputes, from any final decision of the Contracting Officer.

(f) Liquidated damages shall be in addition to any other remedies that the Government may have.

(End of clause)

52.219-25 SMALL DISADVANTAGED BUSINESS PARTICIPATION PROGRAM—DISADVANTAGED STATUS AND REPORTING (OCT 1999)

(a) Disadvantaged status for joint venture partners, team members, and subcontractors. This clause addresses disadvantaged status for joint venture partners, teaming arrangement members, and subcontractors and is applicable if this contract contains small disadvantaged business (SDB) participation targets. The Contractor shall obtain representations of small disadvantaged status from joint venture partners, teaming arrangement members, and subcontractors through use of a provision substantially the same as paragraph (b)(1)(i) of the provision at FAR 52.219-22, Small Disadvantaged Business Status. The Contractor shall confirm that a joint venture partner, team member, or subcontractor representing itself as a small disadvantaged business concern, is identified as a certified small disadvantaged business in the database maintained by the Small Business Administration (PRO-Net) or by contacting the SBA's Office of Small Disadvantaged Business Certification and Eligibility.

(b) Reporting requirement. If this contract contains SDB participation targets, the Contractor shall report on the participation of SDB concerns at contract completion, or as otherwise provided in this contract. Reporting may be on Optional Form 312, Small Disadvantaged Business Participation Report, or in the Contractor's own format providing the same information. This report is required for each contract containing SDB participation targets. If this contract contains an individual Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, reports may be submitted with the final Subcontracting Report for Individual Contracts (Standard Form 294) at the completion of the contract.

(End of clause)

52.222-1 NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997)

If the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the Contractor shall immediately give notice, including all relevant information, to the Contracting Officer.

(End of clause)

52.222-3 CONVICT LABOR (AUG 1996)

The Contractor agrees not to employ in the performance of this contract any person undergoing a sentence of imprisonment which has been imposed by any court of a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands. This limitation, however, shall not prohibit the employment by the Contractor in the performance of this contract of persons on parole or probation to work at paid employment during the term of their sentence or persons who have been pardoned or who have served their terms. Nor shall it prohibit the employment by the Contractor in the performance of this contract of persons confined for violation of the laws of any of the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

(a)(1) The worker is paid or is in an approved work training program on a voluntary basis;

(2) Representatives of local union central bodies or similar labor union organizations have been consulted;

(3) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services;

and

(4) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and

(b) The Attorney General of the United States has certified that the work-release laws or regulations of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943.

(End of clause)

52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT - OVERTIME COMPENSATION. (SEP 2000)

(a) Overtime requirements. No Contractor or subcontractor employing laborers or mechanics (see Federal Acquisition Regulation 22.300) shall require or permit them to work over 40 hours in any workweek unless they are paid at least 1 and 1/2 times the basic rate of pay for each hour worked over 40 hours.

(b) Violation; liability for unpaid wages; liquidated damages. The responsible Contractor and subcontractor are liable for unpaid wages if they violate the terms in paragraph (a) of this clause. In addition, the Contractor and subcontractor are liable for liquidated damages payable to the Government. The Contracting Officer will assess liquidated damages at the rate of $10 per affected employee for each calendar day on which the employer required or permitted the employee to work in excess of the standard workweek of 40 hours without paying overtime wages required by the Contract Work Hours and Safety Standards Act.

(c) Withholding for unpaid wages and liquidated damages. The Contracting Officer will withhold from payments due under the contract sufficient funds required to satisfy any Contractor or subcontractor liabilities for unpaid wages and liquidated damages. If amounts withheld under the contract are insufficient to satisfy Contractor or subcontractor liabilities, the Contracting Officer will withhold payments from other Federal or Federally assisted contracts held by the same Contractor that are subject to the Contract Work Hours and Safety Standards Act.

(d) Payrolls and basic records.

(1) The Contractor and its subcontractors shall maintain payrolls and basic payroll records for all laborers and mechanics working on the contract during the contract and shall make them available to the Government until 3 years after contract completion. The records shall contain the name and address of each employee, social security number, labor classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. The records need not duplicate those required for construction work by Department of Labor regulations at 29 CFR 5.5(a)(3) implementing the Davis-Bacon Act.

(2) The Contractor and its subcontractors shall allow authorized representatives of the Contracting Officer or the Department of Labor to inspect, copy, or transcribe records maintained under paragraph (d)(1) of this clause. The Contractor or subcontractor also shall allow authorized representatives of the Contracting Officer or Department of Labor to interview employees in the workplace during working hours.

(e) Subcontracts. The Contractor shall insert the provisions set forth in paragraphs (a) through (d) of this clause in subcontracts exceeding $100,000 and require subcontractors to include these provisions in any lower tier subcontracts. The Contractor shall be responsible for compliance by any subcontractor or lower-tier subcontractor with the provisions set forth in paragraphs (a) through (d) of this clause.

(End of clause)

52.222-6 DAVIS-BACON ACT (FEB 1995)

(a) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (d) of this clause; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such period. Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (b) of this clause) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(b)(1) The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination.

(ii) The classification is utilized in the area by the construction industry.

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (b)(2) and (b)(3) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(c) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(e) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(End of clause)

52.222-7 WITHHOLDING OF FUNDS (FEB 1988)

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(End of clause)

52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Davis-Bacon Act, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable

programs.

(b)(1) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph (a) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2) of this clause.

(4) The falsification of any of the certifications in this clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(End of clause)

52.222-9 APPRENTICES AND TRAINEES (FEB 1988)

(a) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a

State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) Equal employment opportunity. The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(End of clause)

52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

(End of clause)

52.222-11 SUBCONTRACTS (LABOR STANDARDS (FEB 1988)

(a) The Contractor or subcontractor shall insert in any subcontracts the clauses entitled Davis-Bacon Act, Contract Work Hours and Safety Standards Act-Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Withholding of Funds, Subcontracts (Labor Standards), Contract Termination-Debarment, Disputes Concerning Labor Standards, Compliance with Davis-Bacon and Related Act Regulations, and Certification of Eligibility, and such other clauses as the Contracting Officer may, by appropriate instructions, require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with all the contract clauses cited in this paragraph.

(b)(1) Within 14 days after award of the contract, the Contractor shall deliver to the Contracting Officer a completed Statement and Acknowledgment Form (SF 1413) for each subcontract, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (a) of this clause have been included in the subcontract.

(f) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall deliver to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

(End of clause)

52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)

A breach of the contract clauses entitled Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Davis-Bacon and Related Act Regulations, or Certification of Eligibility may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.

(End of clause)

52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988)

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are hereby incorporated by reference in this contract.

(End of clause)

52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees

or their representatives.

(End of clause)

52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)

(a) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(f)The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(End of clause)

52.222-21 PROHIBITION OF SEGREGATED FACILITIES (FEB 1999)

(a) Segregated facilities, as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(b) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

(End of clause)

52.222-26 EQUAL OPPORTUNITY (APR 2002)

(a) Definition. United States, as used in this clause, means the 50 States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, the U.S. Virgin Islands, and Wake Island.

(b) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of $10,000, the Contractor shall comply with paragraphs (b)(1) through (b)(11) of this clause, except for work performed outside the United States by employees who were not recruited within the United States. Upon request, the Contractor shall provide information necessary to determine the applicability of this clause.

(1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. However, it shall not be a violation of this clause for the Contractor to extend a publicly announced preference in employment to Indians living on or near an Indian reservation, in connection with employment opportunities on or near an Indian reservation, as permitted by 41 CFR 60-1.5.

(2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (i) employment, (ii) upgrading, (iii) demotion, (iv) transfer, (v) recruitment or recruitment advertising, (vi) layoff or termination, (vii) rates of pay or other forms of compensation, and (viii) selection for training, including apprenticeship.

(3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

(4) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(5) The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(6) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(7) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. The Contractor shall also file Standard Form 100 (EEO-1), or any successor form, as prescribed in 41 CFR part 60-1. Unless the Contractor has filed within the 12 months preceding the date of contract award, the Contractor shall, within 30 days after contract award, apply to either the regional Office of Federal Contract Compliance Programs (OFCCP) or the local office of the Equal Employment Opportunity Commission for the necessary forms.

(8) The Contractor shall permit access to its premises, during normal business hours, by the contracting agency or the OFCCP for the purpose of conducting on-site compliance evaluations and complaint investigations. The Contractor shall permit the Government to inspect and copy any books, accounts, records (including computerized records), and other material that may be relevant to the matter under investigation and pertinent to compliance with Executive Order 11246, as amended, and rules and regulations that implement the Executive Order.

(9) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended; in the rules, regulations, and orders of the Secretary of Labor; or as otherwise provided by law.

(10) The Contractor shall include the terms and conditions of subparagraphs (b)(1) through (11) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(11) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting officer may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance;

provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(c) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.

(End of clause)

52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (FEB 1999)

(a) Definitions. "Covered area," as used in this clause, means the geographical area described in the solicitation for this contract.

"Deputy Assistant Secretary," as used in this clause, means Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, or a designee.

"Employer's identification number," as used in this clause, means the Federal Social Security number used on the employer's quarterly federal tax return, U.S. Treasury Department Form 941.

"Minority," as used in this clause, means--

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin); and

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade, each such subcontract in excess of $10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction

work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations, and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Deputy Assistant Secretary when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) of this clause.

(6) Disseminate the Contractor's equal employment policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions. Conduct review of this policy with all on-site supervisory personnel before initiating construction work at a job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to, and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for, through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user rest rooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative action obligations contained in subparagraphs (g)(1) through (16) of this clause. The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participant may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16) of this clause, provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Makes a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246, as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to carry out these sanctions and penalties as ordered shall be a violation of this clause and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) of this clause, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Deputy Assistant Secretary shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different

standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(End of clause)

52.222-35 EQUAL OPPORTUNITY FOR SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (DEC 2001)

(a) Definitions. As used in this clause--

All employment openings means all positions except executive and top management, those positions that will be filled from within the Contractor's organization, and positions lasting 3 days or less. This term includes full-time employment, temporary employment of more than 3 days duration, and part-time employment.

Executive and top management means any employee--

(1) Whose primary duty consists of the management of the enterprise in which the individual is employed or of a customarily recognized department or subdivision thereof;

(2) Who customarily and regularly directs the work of two or more other employees;

(3) Who has the authority to hire or fire other employees or whose suggestions and recommendations as to the hiring or firing and as to the advancement and promotion or any other change of status of other employees will be given particular weight;

(4) Who customarily and regularly exercises discretionary powers; and

(5) Who does not devote more than 20 percent or, in the case of an employee of a retail or service establishment, who does not devote more than 40 percent of total hours of work in the work week to activities that are not directly and closely related to the performance of the work described in paragraphs (1) through (4) of this definition. This paragraph (5) does not apply in the case of an employee who is in sole charge of an establishment or a physically separated branch establishment, or who owns at least a 20 percent interest in the enterprise in which the individual is employed.

Other eligible veteran means any other veteran who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized.

Positions that will be filled from within the Contractor's organization means employment openings for which the Contractor will give no consideration to persons outside the Contractor's organization (including any affiliates, subsidiaries, and parent companies) and includes any openings the Contractor proposes to fill from regularly established “recall” lists. The exception does not apply to a particular opening once an employer decides to consider applicants outside of its organization.

Qualified special disabled veteran means a special disabled veteran who satisfies the requisite skill, experience, education, and other job-related requirements of the employment position such veteran holds or desires, and who, with or without reasonable accommodation, can perform the essential functions of such position.

Special disabled veteran means--

(1) A veteran who is entitled to compensation (or who but for the receipt of military retired pay would be entitled to compensation) under laws administered by the Department of Veterans Affairs for a disability--

(i) Rated at 30 percent or more; or

(ii) Rated at 10 or 20 percent in the case of a veteran who has been determined under 38 U.S.C. 3106 to have a serious employment handicap (i.e., a significant impairment of the veteran's ability to prepare for, obtain, or retain employment consistent with the veteran's abilities, aptitudes, and interests); or

(2) A person who was discharged or released from active duty because of a service-connected disability.

Veteran of the Vietnam era means a person who--

(1) Served on active duty for a period of more than 180 days and was discharged or released from active duty with other than a dishonorable discharge, if any part of such active duty occurred--

(i) In the Republic of Vietnam between February 28, 1961, and May 7, 1975; or

(ii) Between August 5, 1964, and May 7, 1975, in all other cases; or

(2) Was discharged or released from active duty for a service-connected disability if any part of the active duty was performed--

(i) In the Republic of Vietnam between February 28, 1961, and May 7, 1975; or

(ii) Between August 5, 1964, and May 7, 1975, in all other cases.
(b) General. (1) The Contractor shall not discriminate against the individual because the individual is a special disabled veteran, a veteran of the Vietnam era, or other eligible veteran, regarding any position for which the employee or applicant for employment is qualified. The Contractor shall take affirmative action to employ, advance in employment, and otherwise treat qualified special disabled veterans, veterans of the Vietnam era, and other eligible veterans without discrimination based upon their disability or veterans' status in all employment practices such as--

(i) Recruitment, advertising, and job application procedures;

(ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff and rehiring;

(iii) Rate of pay or any other form of compensation and changes in compensation;

(iv) Job assignments, job classifications, organizational structures, position descriptions, lines of progression, and seniority lists;

(v) Leaves of absence, sick leave, or any other leave;

(vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;

(vii) Selection and financial support for training, including apprenticeship, and on-the-job training under 38 U.S.C. 3687, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;

(viii) Activities sponsored by the Contractor including social or recreational programs; and

(ix) Any other term, condition, or privilege of employment.

(2) The Contractor shall comply with the rules, regulations, and relevant orders of the Secretary of Labor issued under the Vietnam Era Veterans' Readjustment Assistance Act of 1972 (the Act), as amended (38 U.S.C. 4211 and 4212).

(c) Listing openings. (1) The Contractor shall immediately list all employment openings that exist at the time of the execution of this contract and those which occur during the performance of this contract, including those not generated by this contract, and including those occurring at an establishment of the Contractor other than the one where the contract is being performed, but excluding those of independently operated corporate affiliates, at an appropriate local public employment service office of the State wherein the opening occurs. Listing employment openings with the U.S. Department of Labor's America's Job Bank shall satisfy the requirement to list jobs with the local employment service office.

(2) The Contractor shall make the listing of employment openings with the local employment service office at least concurrently with using any other recruitment source or effort and shall involve the normal obligations of placing a bona fide job order, including accepting referrals of veterans and nonveterans. This listing of employment openings does not require hiring any particular job applicant or hiring from any particular group of job applicants and is not intended to relieve the Contractor from any requirements of Executive orders or regulations concerning nondiscrimination in employment.

(3) Whenever the Contractor becomes contractually bound to the listing terms of this clause, it shall advise the State public employment agency in each State where it has establishments of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these terms and has so advised the State agency, it need not advise the State agency of subsequent contracts. The Contractor may advise the State agency when it is no longer bound by this contract clause.

(d) Applicability. This clause does not apply to the listing of employment openings that occur and are filled outside the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, American Samoa, Guam, the Virgin Islands of the United States, and Wake Island.

(e) Postings. (1) The Contractor shall post employment notices in conspicuous places that are available to employees and applicants for employment.

(2) The employment notices shall--

(i) State the rights of applicants and employees as well as the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified employees and applicants who are special disabled veterans, veterans of the Vietnam era, and other eligible veterans; and

(ii) Be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance Programs, Department of Labor (Deputy Assistant Secretary of Labor), and provided by or through the Contracting Officer.

(3) The Contractor shall ensure that applicants or employees who are special disabled veterans are informed of the contents of the notice (e.g., the Contractor may have the notice read to a visually disabled veteran, or may lower the posted notice so that it can be read by a person in a wheelchair).

(4) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement, or other contract understanding, that the Contractor is bound by the terms of the Act and is committed to take affirmative action to employ, and advance in employment, qualified special disabled veterans, veterans of the Vietnam era, and other eligible veterans.

(f) Noncompliance. If the Contractor does not comply with the requirements of this clause, the Government may take appropriate actions under the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant to the Act.

(g) Subcontracts. The Contractor shall insert the terms of this clause in all subcontracts or purchase orders of $25,000 or more unless exempted by rules, regulations, or orders of the Secretary of Labor. The Contractor shall act as specified by the Deputy Assistant Secretary of Labor to enforce the terms, including action for noncompliance.

(End of clause)

52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)

(a) General. (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against any employee or applicant because of physical or mental disability. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified individuals with disabilities without discrimination based upon their physical or mental disability in all employment practices such as--

(i) Recruitment, advertising, and job application procedures;

(ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff, and rehiring;

(iii) Rates of pay or any other form of compensation and changes in compensation;

(iv) Job assignments, job classifications, organizational structures, position descriptions, lines of progression, and seniority lists;

(v) Leaves of absence, sick leave, or any other leave;

(vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;

(vii) Selection and financial support for training, including apprenticeships, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;

(viii) Activities sponsored by the Contractor, including social or recreational programs; and

(ix) Any other term, condition, or privilege of employment.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Rehabilitation Act of 1973 (29 U.S.C. 793) (the Act), as amended.

(b) Postings. (1) The Contractor agrees to post employment notices stating--

(i) The Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified individuals with disabilities; and

(ii) The rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. The Contractor shall ensure that applicants and employees with disabilities are informed of the contents of the notice (e.g., the Contractor may have the notice read to a visually disabled individual, or may lower the posted notice so that it might be read by a person in a wheelchair). The notices shall be in a form prescribed by the Deputy

Assistant Secretary for Federal Contract Compliance of the U.S. Department of Labor (Deputy Assistant Secretary) and shall be provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Act and is committed to take affirmative action to employ, and advance in employment, qualified individuals with physical or mental disabilities.

(c) Noncompliance. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(d) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of $10,000 unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

(End of clause)

52.222-37 EMPLOYMENT REPORTS ON SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (DEC 2001)

(a) Unless the Contractor is a State or local government agency, the Contractor shall report at least annually, as required by the Secretary of Labor, on--

(1) The number of disabled veterans and the number of veterans of the Vietnam era in the workforce of the contractor by job category and hiring location; and

(2) The total number of new employees hired during the period covered by the report, and of that total, the number of disabled veterans, and the number of veterans of the Vietnam era.

(b) The above items shall be reported by completing the form entitled "Federal Contractor Veterans' Employment Report VETS-100."

(c) Reports shall be submitted no later than September 30 of each year beginning September 30, 1988.

(d) The employment activity report required by paragraph (a)(2) of this clause shall reflect total hires during the most recent 12-month period as of the ending date selected for the employment profile report required by paragraph (a)(1) of this clause. Contractors may select an ending date: (1) As of the end of any pay period during the period January through March 1st of the year the report is due, or (2) as of December 31, if the contractor has previous written approval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(e) The count of veterans reported according to paragraph (a) of this clause shall be based on voluntary disclosure. Each Contractor subject to the reporting requirements at 38 U.S.C. 4212 shall invite all disabled veterans and veterans of the Vietnam era who wish to benefit under the affirmative action program at 38 U.S.C. 4212 to identify themselves to the Contractor. The invitation shall state that the information is voluntarily provided; that the information will be kept confidential; that disclosure or refusal to provide the information will not subject the applicant or employee to any adverse treatment; and that the information will be used only in accordance with the regulations promulgated under 38 U.S.C. 4212.

(f) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations, or orders of the Secretary.

(End of clause)

52.223-5 POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (APR 1998)

(a) Executive Order 12856 of August 3, 1993, requires Federal facilities to comply with the provisions of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA)(42 U.S.C. 11001-11050) and the Pollution Prevention Act of 1990 (PPA)(42 U.S.C. 13101-13109).

(b) The Contractor shall provide all information needed by the Federal facility to comply with the emergency planning reporting requirements of Section 302 of EPCRA; the emergency notice requirements of Section 304 of EPCRA; the list of Material Safety Data Sheets required by Section 311 of EPCRA; the emergency and hazardous chemical inventory forms of Section 312 of EPCRA; the toxic chemical release inventory of Section 313 of EPCRA, which includes the reduction and recycling information required by Section 6607 of PPA; and the toxic chemical reduction goals requirements of Section 3-302 of Executive Order 12856.

(End of clause)

52.223-6 DRUG-FREE WORKPLACE (MAY 2001)

(a) Definitions. As used in this clause --

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to deter- mine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession, or use of any controlled substance.

"Drug-free workplace" means the site(s) for the performance of work done by the Contractor in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract. "Directly engaged" is defined to include all direct cost employees and any other Contractor employee who has other than a minimal impact or involvement in contract performance.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) The Contractor, if other than an individual, shall-- within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction.

(5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

(i) Taking appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) though (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.

(d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

(End of clause)

52.223-14 TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Unless otherwise exempt, the Contractor, as owner or operator of a facility used in the performance of this contract, shall file by July 1 for the prior calendar year an annual Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023(a) and (g)), and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106). The

Contractor shall file, for each facility subject to the Form R filing and reporting requirements, the annual Form R throughout the life of the contract.

(b) A Contractor owned or operated facility used in the performance of this contract is exempt from the requirement to file an annual Form R if--

(1) The facility does not manufacture, process, or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

(2) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);

(3) The facility does not meet the reporting thresholds of toxic chemicals established under of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

(4) The facility does not fall within Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

(5) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(c) If the Contractor has certified to an exemption in accordance with one or more of the criteria in paragraph (b) of this clause, and after award of the contract circumstances change so that any of its owned or operated facilities used in the performance of this contract is no longer exempt--

(1) The Contractor shall notify the Contracting Officer; and

(2) The Contractor, as owner or operator of a facility used in the performance of this contract that is no longer exempt, shall (i) submit a Toxic Chemical Release Inventory Form (Form R) on or before July 1 for the prior calendar year during which the facility becomes eligible; and (ii) continue to file the annual Form R for the life of the contract for such facility.

(d) The Contracting Officer may terminate this contract or take other action as appropriate, if the Contractor fails to comply accurately and fully with the EPCRA and PPA toxic chemical release filing and reporting requirements.

(e) Except for acquisitions of commercial items, as defined in FAR Part 2, the Contractor shall--

(1) For competitive subcontracts expected to exceed $100,000 (including all options), include a solicitation provision substantially the same as the provision at FAR 52.223-13, Certification of Toxic Chemical Release Reporting; and

(2) Include in any resultant subcontract exceeding $100,000 (including all options), the substance of this clause, except this paragraph (e).

(End of clause)

2.225-11 BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JUL 2002)

(a) Definitions. As used in this clause--

Component means an article, material, or supply incorporated directly into a construction material.

Construction material means an article, material, or supply brought to the construction site by the Contractor or subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

Cost of components means--

(1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

(2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the end product.

Designated country means any of the following countries: Aruba, Austria, Bangladesh, Belgium, Benin, Bhutan, Botswana, Burkina Faso, Burundi, Canada, Cape Verde, Central African Republic, Chad, Comoros, Denmark.

Djibouti, Equatorial Guinea, Finland, France, Gambia, Germany, Greece, Guinea, Guinea-Bissau, Haiti, Hong Kong, Ireland, Israel, Italy, Japan.

Kiribati, Korea, Republic of, Lesotho, Liechtenstein, Luxembourg, Malawi, Maldives, Mali, Mozambique, Nepal, Netherlands, Niger, Norway, Portugal, Rwanda.

Sao Tome and Principe, Sierra Leone, Singapore, Somalia, Spain, Sweden, Switzerland, Tanzania U.R., Togo, Tuvalu, Uganda, United Kingdom, Vanuatu, Western Samoa, Yemen.

Designated country construction material means a construction material that--

(1) Is wholly the growth, product, or manufacture of a designated country; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

Domestic construction material means--

(1) An unmanufactured construction material mined or produced in the United States; or

(2) A construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic.

Foreign construction material means a construction material other than a domestic construction material.

North American Free Trade Agreement country means Canada or Mexico.

North American Free Trade Agreement country construction material means a construction material that--

(1) Is wholly the growth, product, or manufacture of a North American Free Trade Agreement (NAFTA) country; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a NAFTA country into a new and different construction material distinct from the materials from which it was transformed.

United States means the 50 States and the District of Columbia, U.S. territories and possessions, Puerto Rico, the Northern Mariana Islands, and any other place subject to U.S. jurisdiction, but does not include leased bases.

(b) Construction materials. (1) This clause implements the Buy American Act (41 U.S.C. 10a-10d) and the Balance of Payments Program by providing a preference for domestic construction material. In addition, the Contracting Officer has determined that the Trade Agreements Act and the North American Free Trade Agreement (NAFTA) apply to this acquisition. Therefore, the Buy American Act restrictions are waived for designated country and NAFTA country construction materials.

(2) The Contractor shall use only domestic, designated country, or NAFTA country construction material in performing this contract, except as provided in paragraphs (b)(3) and (b)(4) of this clause.

(3) The requirement in paragraph (b)(2) of this clause does not apply to the construction materials or components listed by the Government as follows: none

(4) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(3) of this clause if the Government determines that--

(i) The cost of domestic construction material would be unreasonable. The cost of a particular domestic construction material subject to the restrictions of the Buy American Act is unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent;

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(c) Request for determination of inapplicability of the Buy American Act.

(1)(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(4) of this clause shall include adequate information for Government evaluation of the request, including--

(A) A description of the foreign and domestic construction materials;

(B) Unit of measure;

(C) Quantity;

(D) Price;

(E) Time of delivery or availability;

(F) Location of the construction project;

(G) Name and address of the proposed supplier; and

(H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.

(ii) A request based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause.

(iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.

(2) If the Government determines after contract award that an exception to the Buy American Act applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(4)(i) of this clause.

(3) Unless the Government determines that an exception to the Buy American Act applies, use of foreign construction material is noncompliant with the Buy American Act.

(d) Data. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

Foreign and Domestic Construction Materials Price Comparison

Construction material description	Unit of measure	Quantity	Price (dollars) \1\
Item 1:			
Foreign construction material....	.....	.....	.....
Domestic construction material...	.....	.....	.....
Item 2:			
Foreign construction material....	.....	.....	.....
Domestic construction material...	.....	.....	.....

\1\ Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).

List name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.

Include other applicable supporting information.

(End of clause)

52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (JUL 2000)

(a) The Contractor shall not acquire, for use in the performance of this contract, any supplies or services originating from sources within, or that were located in or transported from or through, countries whose products are banned

from importation into the United States under regulations of the Office of Foreign Assets Control, Department of the Treasury. Those countries are Cuba, Iran, Iraq, Libya, North Korea, Sudan, the territory of Afghanistan controlled by the Taliban, and Serbia (excluding the territory of Kosovo).

(b) The Contractor shall not acquire for use in the performance of this contract any supplies or services from entities controlled by the government of Iraq.

(c) The Contractor shall insert this clause, including this paragraph (c), in all subcontracts.

(End of clause)

52.227-1 AUTHORIZATION AND CONSENT (JUL 1995)

(a) The Government authorizes and consents to all use and manufacture, in performing this contract or any subcontract at any tier, of any invention described in and covered by a United States patent (1) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract or (2) used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with (i) specifications or written provisions forming a part of this contract or (ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clause, if any, included in this contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

(b) The Contractor agrees to include, and require inclusion of, this clause, suitably modified to identify the parties, in all subcontracts at any tier for supplies or services (including construction, architect-engineer services, and materials, supplies, models, samples, and design or testing services expected to exceed the simplified acquisition threshold (however, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, does not affect this authorization and consent.)

(End of clause)

52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)

Except as otherwise provided, the Contractor agrees to indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.

(End of clause)

52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying

labor or materials under this contract if--

(a) Any surety upon any bond, or issuing financial institution for other security, furnished with this contract becomes unacceptable to the Government.

(b) Any surety fails to furnish reports on its financial condition as required by the Government;

(c) The contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer; or

(d) An irrevocable letter of credit (ILC) used as security will expire before the end of the period of required security. If the Contractor does not furnish an acceptable extension or replacement ILC, or other acceptable substitute, at least 30 days before an ILC's scheduled expiration, the Contracting officer has the right to immediately draw on the ILC.

(End of clause)

52.228-11 PLEDGES OF ASSETS (FEB 1992)

(a) Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond--

(1) Pledge of assets; and

(2) Standard Form 28, Affidavit of Individual Surety.

(b) Pledges of assets from each person acting as an individual surety shall be in the form of--

(1) Evidence of an escrow account containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government securities held in book entry form) and/or;

(2) A recorded lien on real estate. The offeror will be required to provide--

(i) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice. This title evidence must show fee simple title vested in the surety along with any concurrent owners; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(ii) Evidence of the amount due under any encumbrance shown in the evidence of title;

(iii) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

(End of clause)

52.228-12 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS. (OCT 1995)

In accordance with Section 806(a)(3) of Pub. L. 102-190, as amended by Sections 2091 and 8105 of Pub. L. 103-355,

upon the request of a prospective subcontractor or supplier offering to furnish labor or material for the performance of this contract for which a payment bond has been furnished to the Government pursuant to the Miller Act, the Contractor shall promptly provide a copy of such payment bond to the requester.

(End of clause)

52.228-14 IRREVOCABLE LETTER OF CREDIT (DEC 1999)

(a) “Irrevocable letter of credit” (ILC), as used in this clause, means a written commitment by a federally insured financial institution to pay all or part of a stated amount of money, until the expiration date of the letter, upon presentation by the Government (the beneficiary) of a written demand therefor. Neither the financial institution nor the offeror/Contractor can revoke or condition the letter of credit.

(b) If the offeror intends to use an ILC in lieu of a bid bond, or to secure other types of bonds such as performance and payment bonds, the letter of credit and letter of confirmation formats in paragraphs (e) and (f) of this clause shall be used.

(c) The letter of credit shall be irrevocable, shall require presentation of no document other than a written demand and the ILC (including confirming letter, if any), shall be issued/confirmed by an acceptable federally insured financial institution as provided in paragraph (d) of this clause, and--

(1) If used as a bid guarantee, the ILC shall expire no earlier than 60 days after the close of the bid acceptance period;

(2) If used as an alternative to corporate or individual sureties as security for a performance or payment bond, the offeror/Contractor may submit an ILC with an initial expiration date estimated to cover the entire period for which financial security is required or may submit an ILC with an initial expiration date that is a minimum period of one year from the date of issuance. The ILC shall provide that, unless the issuer provides the beneficiary written notice of non-renewal at least 60 days in advance of the current expiration date, the ILC is automatically extended without amendment for one year from the expiration date, or any future expiration date, until the period of required coverage is completed and the Contracting Officer provides the financial institution with a written statement waiving the right to payment. The period of required coverage shall be:

(i) For contracts subject to the Miller Act, the later of--

(A) One year following the expected date of final payment;

(B) For performance bonds only, until completion of any warranty period; or

(C) For payment bonds only, until resolution of all claims filed against the payment bond during the one-year period following final payment.

(ii) For contracts not subject to the Miller Act, the later of--

(A) 90 days following final payment; or

(B) For performance bonds only, until completion of any warranty period.

(d) Only federally insured financial institutions rated investment grade or higher shall issue or confirm the ILC. The offeror/Contractor shall provide the Contracting Officer a credit rating that indicates the financial institution has the required rating(s) as of the date of issuance of the ILC. Unless the financial institution issuing the ILC had letter of credit business of less than $25 million in the past year, ILCs over $5 million must be confirmed by another acceptable

financial institution that had letter of credit business of less than $25 million in the past year.

(e) The following format shall be used by the issuing financial institution to create an ILC:

_____

[Issuing Financial Institution's Letterhead or Name and Address]

Issue Date _____

IRREVOCABLE LETTER OF CREDIT NO. _____

Account party's name _____

Account party's address _____

For Solicitation No. _____(for reference only)

TO: [U.S. Government agency]

[U.S. Government agency's address]

1. We hereby establish this irrevocable and transferable Letter of Credit in your favor for one or more drawings up to United States $_____. This Letter of Credit is payable at [issuing financial institution's and, if any, confirming financial institution's] office at [issuing financial institution's address and, if any, confirming financial institution's address] and expires with our close of business on _____, or any automatically extended expiration date.

2. We hereby undertake to honor your or the transferee's sight draft(s) drawn on the issuing or, if any, the confirming financial institution, for all or any part of this credit if presented with this Letter of Credit and confirmation, if any, at the office specified in paragraph 1 of this Letter of Credit on or before the expiration date or any automatically extended expiration date.

3. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this Letter of Credit that it is deemed to be automatically extended without amendment for one year from the expiration date hereof, or any future expiration date, unless at least 60 days prior to any expiration date, we notify you or the transferee by registered mail, or other receipted means of delivery, that we elect not to consider this Letter of Credit renewed for any such additional period. At the time we notify you, we also agree to notify the account party (and confirming financial institution, if any) by the same means of delivery.

4. This Letter of Credit is transferable. Transfers and assignments of proceeds are to be effected without charge to either the beneficiary or the transferee/assignee of proceeds. Such transfer or assignment shall be only at the written direction of the Government (the beneficiary) in a form satisfactory to the issuing financial institution and the confirming financial institution, if any.

5. This Letter of Credit is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution, if any, otherwise state of issuing financial institution].

6. If this credit expires during an interruption of business of this financial institution as described in Article 17 of the UCP, the financial institution specifically agrees to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

_____

[Issuing financial institution]

(f) The following format shall be used by the financial institution to confirm an ILC:

_____
[Confirming Financial Institution's Letterhead or Name and Address]

(Date) _____

Our Letter of Credit Advice Number _____

Beneficiary: _____ [U.S. Government agency]

Issuing Financial Institution: _____

Issuing Financial Institution's LC No.: _____

Gentlemen:

1. We hereby confirm the above indicated Letter of Credit, the original of which is attached, issued by _____ [name of issuing financial institution] for drawings of up to United States dollars _____/U.S. $_____ and expiring with our close of business on _____ [the expiration date], or any automatically extended expiration date.

2. Draft(s) drawn under the Letter of Credit and this Confirmation are payable at our office located at _____.

3. We hereby undertake to honor sight draft(s) drawn under and presented with the Letter of Credit and this Confirmation at our offices as specified herein.

4. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this confirmation that it be deemed automatically extended without amendment for one year from the expiration date hereof, or any automatically extended expiration date, unless:

(a) At least 60 days prior to any such expiration date, we shall notify the Contracting Officer, or the transferee and the issuing financial institution, by registered mail or other receipted means of delivery, that we elect not to consider this confirmation extended for any such additional period; or

(b) The issuing financial institution shall have exercised its right to notify you or the transferee, the account party, and ourselves, of its election not to extend the expiration date of the Letter of Credit.

5. This confirmation is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution].

6. If this confirmation expires during an interruption of business of this financial institution as described in Article 17 of the UCP, we specifically agree to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

_____

[Confirming financial institution]

(g) The following format shall be used by the Contracting Officer for a sight draft to draw on the Letter of Credit:

SIGHT DRAFT

_____

[City, State]

(Date) _____

[Name and address of financial institution]

Pay to the order of _____ [Beneficiary Agency] _____ the sum of United States $_____. This draft is drawn under Irrevocable Letter of Credit No. _____.

_____

[Beneficiary Agency]

By: _____

(End of clause)

52.228-15 PERFORMANCE AND PAYMENT BONDS--CONSTRUCTION (JUL 2000)-

(a) Definitions. As used in this clause--

Original contract price means the award price of the contract; or, for requirements contracts, the price payable for the estimated total quantity; or, for indefinite-quantity contracts, the price payable for the specified minimum quantity. Original contract price does not include the price of any options, except those options exercised at the time of contract award.

(b) Amount of required bonds. Unless the resulting contract price is $100,000 or less, the successful offeror shall furnish performance and payment bonds to the Contracting Officer as follows:

(1) Performance bonds (Standard Form 25). The penal amount of performance bonds at the time of contract award shall be 100 percent of the original contract price.

(2) Payment Bonds (Standard Form 25-A). The penal amount of payment bonds at the time of contract award shall be 100 percent of the original contract price.

(3) Additional bond protection. (i) The Govemment may require additional performance and payment bond protection if the contract price is increased. The increase in protection generally will equal 100 percent of the increase in contract price.

(ii) The Government may secure the additional protection by directing the Contractor to increase the penal amount of the existing bond or to obtain an additional bond.

(c) Furnishing executed bonds. The Contractor shall furnish all executed bonds, including any necessary reinsurance agreements, to the Contracting Officer, within the time period specified in the Bid Guarantee provision of the solicitation, or otherwise specified by the Contracting Officer, but in any event, before starting work.

(d) Surety or other security for bonds. The bonds shall be in the form of firm commitment, supported by corporate sureties whose names appear on the list contained in Treasury Department Circular 570, individual sureties, or by other acceptable security such as postal money order, certified check, cashier's check, irrevocable letter of credit, or, in accordance with Treasury Department regulations, certain bonds or notes of the United States. Treasury Circular 570 is published in the Federal Register or may be obtained from the U.S. Department of Treasury, Financial Management Service, Surety Bond Branch, 401 14th Street, NW, 2nd Floor, West Wing, Washington, DC 20227.

(e) Notice of subcontractor waiver of protection (40 U.S.C. 270b(c). Any waiver of the right to sue on the payment bond is void unless it is in writing, signed by the person whose right is waived, and executed after such person has first furnished labor or material for use in the performance of the contract.

(End of clause)

52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991)

(a) "Contract date," as used in this clause, means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification.

"All applicable Federal, State, and local taxes and duties," as used in this clause, means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"After-imposed Federal tax," as used in this clause, means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative, judicial, or administrative action taking effect after the contract date. It does not include social security tax or other employment taxes.
"After-relieved Federal tax," as used in this clause, means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable on the transactions or property covered by this contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

(b) The contract price includes all applicable Federal, State, and local taxes and duties.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of any after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceeds $250.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption.

(End of clause)

52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (SEP 2002)

(a) Payment of price. The Government shall pay the Contractor the contract price as provided in this contract.

(b) Progress payments. The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the total amount of each subcontract under the contract.

(iv) A listing of the amounts previously paid to each such subcontractor under the contract.

(v) Additional supporting data in a form and detail required by the Contracting Officer.

(2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if--

(i) Consideration is specifically authorized by this contract; and

(ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) Contractor certification. Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.)

I hereby certify, to the best of my knowledge and belief, that--

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) All payments due to subcontractors and suppliers from previous payments received under the contract have been

made, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code;

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and

(4) This certification is not to be construed as final acceptance of a subcontractor's performance.

_____

(Name)

_____

(Title)

_____

(Date)

(d) Refund of unearned amounts. If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall--

(1) Notify the Contracting Officer of such performance deficiency; and

(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the 8th day after the date of receipt of the unearned amount until--

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) Retainage. If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) Title, liability, and reservation of rights. All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) Reimbursement for bond premiums. In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) Final payment. The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against
the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) Limitation because of undefinitized work. Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) Interest computation on unearned amounts. In accordance with 31 U.S.C. 3903(c)(1), the amount payable under subparagraph (d)(2) of this clause shall be--

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

(End of clause)

52.232-17 INTEREST (JUNE 1996)

(a) Except as otherwise provided in this contract under a Price Reduction for Defective Cost or Pricing Data clause or a Cost Accounting Standards clause, all amounts that become payable by the Contractor to the Government under this contract (net of any applicable tax credit under the Internal Revenue Code (26 U.S.C. 1481)) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid. reproduce, prepare derivative works, distribute copies to the public, and (b) Amounts shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination.

(3) The date the Government transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt.

(4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification.

(c) The interest charge made under this clause may be reduced under the procedures prescribed in 32.614-2 of the Federal Acquisition Regulation in effect on the date of this contract.

(End of clause)

52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986) - ALTERNATE I (APR 1984)

(a) The Contractor, under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 15 (hereafter referred to as "the Act"), may assign its rights to be paid amounts due or to become due as a result of the performance of this contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such an assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence. Unless otherwise stated in this contract, payments to an assignee of any amounts due or to become due under this contract shall not, to the extent specified in the Act, be subject to reduction or setoff.

(b) Any assignment or reassignment authorized under the Act and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.

(End of clause)

52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (FEB 2002)

Notwithstanding any other payment terms in this contract, the Government will make invoice payments under the terms and conditions specified in this clause. The Government considers payment as being made on the day a check is dated or the date of an electronic funds transfer. Definitions of pertinent terms are set forth in sections 2.101, 32.001, and 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see paragraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) Invoice payments--(1) Types of invoice payments. For purposes of this clause, there are several types of invoice payments that may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project.

(A) The due date for making such payments is 14 days after the designated billing office receives a proper payment request. If the designated billing office fails to annotate the payment request with the actual date of receipt at the time of receipt, the payment due date is the 14th day after the date of the Contractor's payment request, provided the designated billing office receives a proper payment request and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, is as specified in the contract or, if not specified, 30 days after approval by the Contracting Officer for release to the Contractor.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract).

(A) The due date for making such payments is the later of the following two events:

(1) The 30th day after the designated billing office receives a proper invoice from the Contractor.

(2) The 30th day after Government acceptance of the work or services completed by the Contractor. For a final invoice when the payment amount is subject to contract settlement actions (e.g., release of claims), acceptance is deemed to occur on the effective date of the contract settlement.

(B) If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date is the 30th day after the date of the Contractor's invoice, provided the designated billing office receives a proper invoice and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(2) Contractor's invoice. The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(xi) of this clause. If the invoice does not comply with these requirements, the designated billing office must return it within 7 days after receipt, with the reasons why it is not a proper invoice. When computing any interest penalty owed the Contractor, the Government will take into account if the Government notifies the Contractor of an improper invoice in an untimely manner.

(i) Name and address of the Contractor.

(ii) Invoice date and invoice number. (The Contractor should date invoices as close as possible to the date of mailing or transmission.)

(iii) Contract number or other authorization for work or services performed (including order number and contract line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (e.g., discount for prompt payment terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to notify in the event of a defective invoice.

(viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.

(ix) Taxpayer Identification Number (TIN). The Contractor shall include its TIN on the invoice only if required elsewhere in this contract.

(x) Electronic funds transfer (EFT) banking information.

(A) The Contractor shall include EFT banking information on the invoice only if required elsewhere in this contract.

(B) If EFT banking information is not required to be on the invoice, in order for the invoice to be a proper invoice, the Contractor shall have submitted correct EFT banking information in accordance with the applicable solicitation provision (e.g., 52.232-38, Submission of Electronic Funds Transfer Information with Offer), contract clause (e.g., 52.232-33, Payment by Electronic Funds Transfer--Central Contractor Registration, or 52.232-34, Payment by Electronic Funds Transfer--Other Than Central Contractor Registration), or applicable agency procedures.

(C) EFT banking information is not required if the Government waived the requirement to pay by EFT.

(xi) Any other information or documentation required by the contract.

(3) Interest penalty. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if payment is not made by the due date and the conditions listed in paragraphs (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday, the designated payment office may make payment on the following working day without incurring a late payment interest penalty.

(i) The designated billing office received a proper invoice.

(ii) The Government processed a receiving report or other Government documentation authorizing payment and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) Computing penalty amount. The Government will compute the interest penalty in accordance with the Office of Management and Budget prompt payment regulations at 5 CFR part 1315.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in paragraph (a)(1)(ii) of this clause, Government acceptance or approval is deemed to occur constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. If actual acceptance or approval occurs within the constructive acceptance or approval period, the Government will base the determination of an interest penalty on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The prompt payment regulations at 5 CFR 1315.10(c) do not require the Government to pay interest penalties if payment delays are due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the

terms of the contract. The Government and the Contractor shall resolve claims involving disputes, and any interest that may be payable in accordance with the clause at FAR 52.233-1, Disputes.

(5) Discounts for prompt payment. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if the Government takes a discount for prompt payment improperly. The Government will calculate the interest penalty in accordance with the prompt payment regulations at 5 CFR part 1315.

(6) Additional interest penalty. (i) The designated payment office will pay a penalty amount, calculated in accordance with the prompt payment regulations at 5 CFR part 1315 in addition to the interest penalty amount only if--

(A) The Government owes an interest penalty of $1 or more;

(B) The designated payment office does not pay the interest penalty within 10 days after the date the invoice amount is paid; and

(C) The Contractor makes a written demand to the designated payment office for additional penalty payment, in accordance with paragraph (a)(6)(ii) of this clause, postmarked not later than 40 days after the date the invoice amount is paid.

(ii)(A) The Contractor shall support written demands for additional penalty payments with the following data. The Government will not request any additional data. The Contractor shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) If there is no postmark or the postmark is illegible--

(1) The designated payment office that receives the demand will annotate it with the date of receipt provided the demand is received on or before the 40th day after payment was made; or

(2) If the designated payment office fails to make the required annotation, the Government will determine the demand's validity based on the date the Contractor has placed on the demand, provided such date is no later than the 40th day after payment was made.

(b) Contract financing payments. If this contract provides for contract financing, the Government will make contract financing payments in accordance with the applicable contract financing clause.

(c) Subcontract clause requirements. The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) Prompt payment for subcontractors. A payment clause that obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) Interest for subcontractors. An interest penalty clause that obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(3) Subcontractor clause flowdown. A clause requiring each subcontractor to use:

(i) Include a payment clause and an interest penalty clause conforming to the standards set forth in paragraphs (c)(1) and (c)(2) of this clause in each of its subcontracts; and

(ii) Require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) Subcontract clause interpretation. The clauses required by paragraph (c) of this clause shall not be construed to impair the right of the Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that--

(1) Retainage permitted. Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(2) Withholding permitted. Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) Withholding requirements. Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) The Contractor furnishes to the Contracting Officer a copy of any notice issued by a Contractor pursuant to paragraph (d)(3)(i) of this clause.

(e) Subcontractor withholding procedures. If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) Subcontractor notice. Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) Contracting Officer notice. Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to paragraph (e)(1) of this clause;

(3) Subcontractor progress payment reduction. Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (e)(1) of this clause;

(4) Subsequent subcontractor payment. Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under paragraph (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) Notice to Contracting Officer. Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under paragraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) Interest to Government. Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under paragraph (e)(5)(i) of this clause.

(f) Third-party deficiency reports--(1) Withholding from subcontractor. If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a “second-tier subcontractor”) a written notice in accordance with section 2 of the Act of August 24, 1935 (40 U.S.C. 270b, Miller Act), asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under paragraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) Subsequent payment or interest charge. As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall--

(i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or

(ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments

under section 12 of the Contracts DisputesAct of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) Written notice of subcontractor withholding. The Contractor shall issue a written notice of any withholding to a subcontractor (with a copy furnished to the Contracting Officer), specifying--

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) Subcontractor payment entitlement. The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) Prime-subcontractor disputes. A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the Government is a party. The Government may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) Preservation of prime-subcontractor rights. Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) Non-recourse for prime contractor interest penalty. The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the Government for such interest penalty. A cost-reimbursement claim may not include any amount for reimbursement of such interest penalty.

(l) Overpayments. If the Contractor becomes aware of a duplicate payment or that the Government has otherwise overpaid on an invoice payment, the Contractor shall immediately notify the Contracting Officer and request instructions for disposition of the overpayment.

(End of clause)

52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—CENTRAL CONTRACTOR REGISTRATION (MAY 1999)

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) of this clause. As used in this clause, the term “EFT” refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either--

(i) Accept payment by check or some other mutually agreeable method of payment; or

(ii) Request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (d) of this clause).

(b) Contractor's EFT information. The Government shall make payment to the Contractor using the EFT information contained in the Central Contractor Registration (CCR) database. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the CCR database.

(c) Mechanisms for EFT payment. The Government may make payment by EFT through either the Automated Clearing House (ACH) network, subject to the rules of the National Automated Clearing House Association, or the Fedwire Transfer System. The rules governing Federal payments through the ACH are contained in 31 CFR part 210.

(d) Suspension of payment. If the Contractor's EFT information in the CCR database is incorrect, then the Government need not make payment to the Contractor under this contract until correct EFT information is entered into the CCR database; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(e) Contractor EFT arrangements. If the Contractor has identified multiple payment receiving points (i.e., more than one remittance address and/or EFT information set) in the CCR database, and the Contractor has not notified the Government of the payment receiving point applicable to this contract, the Government shall make payment to the first payment receiving point (EFT information set or remittance address as applicable) listed in the CCR database.

(f) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government used the Contractor's EFT information incorrectly, the Government remains responsible for--

(i) Making a correct payment;

(ii) Paying any prompt payment penalty due; and

(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and--

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the Contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (d) of this clause shall apply.

(g) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(h) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee shall register in the CCR database and shall be paid by EFT in accordance with the terms of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (d) of this clause.

(i) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(j) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Government makes payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in the CCR database.

(End of Clause)

52.233-1 DISPUTES. (JUL 2002)

(a) This contract is subject to the Contract Disputes Act of 1978, as amended (41 U.S.C. 601-613).

(b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved under this clause.

(c) Claim, as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding $100,000 is not a claim under the Act until certified. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under the Act. The submission may be converted to a claim under the Act, by complying with the submission and certification requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d)(1) A claim by the Contractor shall be made in writing and, unless otherwise stated in this contract, submitted within 6 years after accrual of the claim to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.

(2)(i) The contractors shall provide the certification specified in subparagraph (d)(2)(iii) of this clause when submitting any claim -

(A) Exceeding $100,000; or

(B) Regardless of the amount claimed, when using -

(1) Arbitration conducted pursuant to 5 U.S.C. 575-580; or

(2) Any other alternative means of dispute resolution (ADR) technique that the agency elects to handle in accordance with the Administrative Dispute Resolution Act (ADRA).

(ii) The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim.

(iii) The certification shall state as follows: "I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable; and that I am duly authorized to

certify the claim on behalf of the Contractor.

(3) The certification may be executed by any person duly authorized to bind the Contractor with respect to the claim.

(e) For Contractor claims of $100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claims over $100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.

(f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in the Act.

(g) If the claim by the Contractor is submitted to the Contracting Officer or a claim by the Government is presented to the Contractor, the parties, by mutual consent, may agree to use alternative disput resolution (ADR). If the Contractor refuses an offer for ADR, the Contractor shall inform the Contracting Officer, in writing, of the Contractor's specific reasons for rejecting the request.

(h) The Government shall pay interest on the amount found due and unpaid from (1) the date the Contracting Officer receives the claim (certified, if required); or (2) the date that payment otherwise would be due, if that date is later, until the date of payment. With regard to claims having defective certifications, as defined in (FAR) 48 CFR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claims shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the Contracting Officer.

(End of clause)

52.233-3 PROTEST AFTER AWARD (AUG. 1996)

(a) Upon receipt of a notice of protest (as defined in FAR 33.101) or a determination that a protest is likely (see FAR 33.102(d)), the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage;

provided, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.

(f) If, as the result of the Contractor's intentional or negligent misstatement, misrepresentation, or miscertification, a protest related to this contract is sustained, and the Government pays costs, as provided in FAR 33.102(b)(2) or 33.104(h)(1), the Government may require the Contractor to reimburse the Government the amount of such costs. In addition to any other remedy available, and pursuant to the requirements of Subpart 32.6, the Government may collect this debt by offsetting the amount against any payment due the Contractor under any contract between the Contractor and the Government.

(End of clause)

52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

As prescribed in 36.502, insert the following clause in solicitations and contracts when a fixed-price construction contract or a fixed-price dismantling, demolition, or removal of improvements contract is contemplated and the contract amount is expected to exceed the small purchase limitation. The Contracting Officer may insert the clause in solicitations and contracts when a fixed-price construction or a fixed-price contract for dismantling, demolition, or removal of improvements is contemplated and the contract amount is expected to be within the small purchase limitation.

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of

(1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or

(2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

(End of clause)

52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to

(1) conditions bearing upon transportation, disposal, handling, and storage of materials;

(2) the availability of labor, water, electric power, and roads;

(3) uncertainties of weather, river stages, tides, or similar physical conditions at the site;

(4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any understanding reached or representation made concerning conditions which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

(End of clause)

52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide full information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

(End of clause)

52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the worksite a competent superintendent who is satisfactory to the Contracting Officer and has authority to act for the Contractor.

(End of clause)

52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

(End of clause)

52.236-8 OTHER CONTRACTS (APR 1984)

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by Government employees.

(End of clause)

52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities

(1) at or near the work site, and

(2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(End of clause)

52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(End of clause)

52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use, notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

(End of clause)

52.236-12 CLEANING UP (APR 1984)

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon completing the work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.

(End of clause)

52.236-13 ACCIDENT PREVENTION (NOV 1991) – ALTERNATE I (NOV 1991)

(a) The Contractor shall provide and maintain work environments and procedures which will

(1) safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities;

(2) avoid interruptions of Government operations and delays in project completion dates; and

(3) control costs in the performance of this contract.

(b) For these purposes on contracts for construction or dismantling, demolition, or removal of improvements, the Contractor shall-

(1) Provide appropriate safety barricades, signs, and signal lights;

(2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and

(3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for the purposes are taken.

(g) If this contract is for construction or dismantling, demolition or removal of improvements with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation.

(c) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Government personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.

(e) The Contractor shall insert this clause, including this paragraph (e), with appropriate changes in the designation of the parties, in subcontracts.

(f) Before commencing the work, the Contractor shall-

(1) Submit a written proposed plan for implementing this clause. The plan shall include an analysis of the significant hazards to life, limb, and property inherent in contract work performance and a plan for controlling these hazards; and

(2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.

(End of clause)

52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)

(a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as directed by the Contracting Officer, and upon doing so shall immediately deliver three copies of the annotated schedule to the Contracting Officer. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

(End of clause)

52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by," or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where "as shown," as indicated", "as detailed", or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place," that is "furnished and installed".

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, or any lower tier subcontractor pursuant to a construction contract, showing in detail (1) the proposed fabrication and assembly of structural elements, and (2) the installation (i.e., fit, and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the contractor to explain in detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government's reasons therefor. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor.

(End of clause)

52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995)

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

(End of clause)

52.242-13 BANKRUPTCY (JUL 1995)

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish, by certified mail or electronic commerce method authorized by the contract, written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identity of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting offices for all Government contracts against which final payment has not been made. This obligation remains in effect until final payment under this contract.

(End of clause)

52.242-14 SUSPENSION OF WORK (APR 1984)

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract. (c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

(End of clause)

52.243-4 CHANGES (AUG 1987)

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

(1) In the specifications (including drawings and designs);

(2) In the method or manner of performance of the work;

(3) In the Government-furnished facilities, equipment, materials, services, or site; or

(4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating

(1) the date, circumstances, and source of the order and

(2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after

(1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of the proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

(End of clause)

52.248-3 VALUE ENGINEERING--CONSTRUCTION (FEB 2000)

(a) General. The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) below.

(b) Definitions. "Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause, means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractors' development and implementation costs (see paragraph (h) below).

"Value engineering change proposal (VECP)" means a proposal that--

(1) Requires a change to this, the instant contract, to implement; and

(2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; provided, that it does not involve a change--

(i) In deliverable end item quantities only; or

(ii) To the contract type only.

(c) VECP preparation. As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for

(i) the affected portions of the existing contract requirement and

(ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) Submission. The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) Government action.

(1) The Contracting Officer will notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer will notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decision. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

If the VECP is not accepted, the Contracting Officer will notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The decision to accept or reject all or part of any VECP is a unilateral decision made solely at the discretion of the Contracting Officer.

(f) Sharing.

(1) Rates. The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by

(i) 45 percent for fixed-price contracts or

(ii) 75 percent for cost-reimbursement contracts.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

(i) Accept the VECP;

(ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) Collateral savings. If a VECP is accepted, the Contracting Officer will increase the instant contract amount by 20 percent of any projected collateral savings determined to be realized in a typical year of use after subtracting any Government costs not previously offset. However, the Contractor's share of collateral savings will not exceed the contract's firm-fixed-price or estimated cost, at the time the VECP is accepted, or $100,000, whichever is greater. The Contracting Officer is the sole determiner of the amount of collateral savings.

(h) Subcontracts. The Contractor shall include an appropriate value engineering clause in any subcontract of $50,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; provided, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(i) Data. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering-- Construction clause of contract . . . . . , shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations." If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

(End of clause)

52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SEP 1996) - ALTERNATE I (SEP 1996)

(a) The Government may terminate performance of work under this contract in whole or, from time to time, in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination, and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

(1) Stop work as specified in the notice.

(2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.

(3) Terminate all subcontracts to the extent they relate to the work terminated.

(4) Assign to the Government, as directed by the Contracting Officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.

(5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and deliver to the Government (i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.

(7) Complete performance of the work not terminated.

(8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.

(9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (b)(6) of this clause; provided, however, that the Contractor (i) is not required to extend credit to

any purchaser and (ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.

(c) The Contractor shall submit complete termination inventory schedules no later than 120 days from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 120-day period.

(d) After expiration of the plant clearance period as defined in Subpart 45.6 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.

(e) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1-year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of information available, the amount, if any, due the Contractor because of the termination and shall pay the amount determined.

(f) Subject to paragraph (e) of this clause, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid or remaining to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (g) or paragraph (g) of this clause, exclusive of costs shown in subparagraph (g)(3) of this clause, may not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be modified, and the Contractor paid the agreed amount. Paragraph (g) of this clause shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(g) If the Contractor and Contracting Officer fail to agree on the whole amount to be paid the Contractor because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (f) of this clause:

(1) For contract work performed before the effective date of termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (g)(1)(i) of this clause; and

(iii) A sum, as profit on subdivision (g)(1)(i) of this clause, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(h) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (g) of this clause, the fair value, as determined by the Contracting Officer, of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer.

(i) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all costs claimed, agreed to, or determined under this clause.

(j) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (e), (g), or (l) of this clause, except that if the Contractor failed to submit the termination settlement proposal or request for equitable adjustment within the time provided in paragraph (e) or (l), respectively, and failed to request a time extension, there is no right of appeal.

(k) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(l) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(m)(1) The Government may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess is repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(n) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under this contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

(End of clause)

52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the Government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if--

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include

(i) acts of God or of the public enemy,

(ii) acts of the Government in either its sovereign or contractual capacity,

(iii) acts of another Contractor in the performance of a contract with the Government,

(iv) fires,

(v) floods,

(vi) epidemics,

(vii) quarantine restrictions,

(viii) strikes,

(ix) freight embargoes,

(x) unusually severe weather, or delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been

issued for the convenience of the Government.

The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.249-5000 BASIS FOR SETTLEMENT OF PROPOSALS

Actual costs will be used to determine equipment costs for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a terminations settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(h) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the contractor's accounting records to determine total actual equipment costs.

(i) If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

(j) Recorded job costs adjusted for unallowable expenses will be used to determine equipment operating expenses.

(4) Ownership costs (depreciation) will be determined using the contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

(End of Clause)

52.253-1 COMPUTER GENERATED FORMS (JAN 1991)

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, provided there is no change to the name, content, or sequence of the data elements on the form, and provided the form carries the Standard or Optional Form number and edition date.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition date.

(k) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

252.201-7000 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)

(a) "Definition. Contracting officer's representative" means an individual designated in accordance with subsection 201.602-2 of the Defense Federal Acquisition Regulation Supplement and authorized in writing by the contracting officer to perform specific technical or administrative functions.

(b) If the Contracting Officer designates a contracting officer's representative (COR), the Contractor will receive a copy of the written designation. It will specify the extent of the COR's authority to act on behalf of the contracting officer. The COR is not authorized to make any commitments or changes that will affect price, quality, quantity, delivery, or any other term or condition of the contract.

(End of clause)

252.203-7001 PROHIBITION ON PERSONS CONVICTED OF FRAUD OR OTHER DEFENSE-CONTRACT-RELATED FELONIES (MAR 1999)

(a) Definitions. As used in this clause—

(1) "Arising out of a contract with the DoD" means any act in connection with—

(i) Attempting to obtain;

(ii) Obtaining, or

(iii) Performing a contract or first-tier subcontract of any agency, department, or component of the Department of Defense (DoD).

(2) "Conviction of fraud or any other felony" means any conviction for fraud or a felony in violation of state or Federal criminal statutes, whether entered on a verdict or plea, including a plea of *nolo contendere*, for which sentence has been imposed.

(3) "Date of conviction" means the date judgment was entered against the individual.

(b) Any individual who is convicted after September 29, 1988, of fraud or any other felony arising out of a contract with the DoD is prohibited from serving--

(1) In a management or supervisory capacity on any DoD contract or first-tier subcontract;

(2) On the board of directors of any DoD contractor or first-tier subcontractor;

(3) As a consultant, agent, or representative for any DoD contractor or first-tier subcontractor; or

(4) In any other capacity with the authority to influence, advise, or control the decisions of any DoD contractor or subcontractor with regard to any DoD contract or first-tier subcontract.

(c) Unless waived, the prohibition in paragraph (b) of this clause applies for not less than 5 years from the date of conviction.

(d) 10 U.S.C. 2408 provides that a defense contractor or first-tier subcontractor shall be subject to a criminal penalty of not more than $500,000 if convicted of knowingly—

(1) Employing a person under a prohibition specified in paragraph (b) of this clause; or

(2) Allowing such a person to serve on the board of directors of the contractor or first-tier subcontractor.

(e) In addition to the criminal penalties contained in 10 U.S.C. 2408, the Government may consider other available remedies, such as—

(1) Suspension or debarment;

(2) Cancellation of the contract at no cost to the Government; or

(3) Termination of the contract for default.

(f) The Contractor may submit written requests for waiver of the prohibition in paragraph (b) of this clause to the Contracting Officer. Requests shall clearly identify—

(1) The person involved;

(2) The nature of the conviction and resultant sentence or punishment imposed;

(3) The reasons for the requested waiver; and

(4) An explanation of why a waiver is in the interest of national security.

(g) The Contractor agrees to include the substance of this clause, appropriately modified to reflect the identity and relationship of the parties, in all first-tier subcontracts exceeding the simplified acquisition threshold in Part 2 of the Federal Acquisition Regulation, except those for commercial items or components.

(h) Pursuant to 10 U.S.C. 2408(c), defense contractors and subcontractors may obtain information as to whether a particular person has been convicted of fraud or any other felony arising out of a contract with the DoD by contacting The Office of Justice Programs, The Denial of Federal Benefits Office, U.S. Department of Justice, telephone (202) 616-3507.

(End of clause)

252.203-7002 DISPLAY OF DOD HOTLINE POSTER (DEC 1991)

(a) The Contractor shall display prominently in common work areas within business segments performing work under Department of Defense (DoD) contracts, DoD Hotline Posters prepared by the DoD Office of the Inspector General.

(b) DoD Hotline Posters may be obtained from the DoD Inspector General, ATTN: Defense Hotline, 400 Army Navy Drive, Washington, DC 22202-2884.

(l) The Contractor need not comply with paragraph (a) of this clause if it has established a mechanism, such as a hotline, by which employees may report suspected instances of improper conduct, and instructions that encourage employees to make such reports.

(End of clause)

252.204-7004 REQUIRED CENTRAL CONTRACTOR REGISTRATION (NOV 2001)

(a) Definitions.

As used in this clause--

(1) Central Contractor Registration (CCR) database means the primary DoD repository for contractor information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun and Bradstreet Information Services to identify unique business entities.

(3) Data Universal Numbering System +4 (DUNS+4) number means the DUNS number assigned by Dun and Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registered in the CCR database means that all mandatory information, including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during performance, and through final payment of any contract resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offeror ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

(c) The Contractor is responsible for the accuracy and completeness of the data within the CCR, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the Contractor is required to confirm on an annual basis that its information in the CCR database is accurate and complete.

(d) Offerors and contractors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at http://www.ccr.gov.

(End of clause)

252.205-7000 PROVISION OF INFORMATION TO COOPERATIVE AGREEMENT HOLDERS (DEC 1991)

(a) Definition.

"Cooperative agreement holder" means a State or local government; a private, nonprofit organization; a tribal organization (as defined in section 4(c) of the Indian Self-Determination and Education Assistance Act (Pub. L. 93-268; 25 U.S.C. 450 (c))); or an economic enterprise (as defined in section 3(e) of the Indian Financing Act of 1974 (Pub. L. 93-362; 25 U.S.C. 1452(e))) whether such economic enterprise is organized for profit or nonprofit purposes; which has an agreement with the Defense Logistics Agency to furnish procurement technical assistance to business entities.

(b) The Contractor shall provide cooperative agreement holders, upon their request, with a list of those appropriate employees or offices responsible for entering into subcontracts under defense contracts. The list shall include the business address, telephone number, and area of responsibility of each employee or office.

(c) The Contractor need not provide the listing to a particular cooperative agreement holder more frequently than once a year.

(End of clause)

252.209-7000 ACQUISITION FROM SUBCONTRACTORS SUBJECT TO ONSITE INSPECTION UNDER THE INTERMEDIATE-RANGE NUCLEAR FORCES (INF) TREATY (NOV 1995)

(a) The Contractor shall not deny consideration for a subcontract award under this contract to a potential subcontractor subject to on-site inspection under the INF Treaty, or a similar treaty, solely or in part because of the actual or potential presence of Soviet inspectors at the subcontractor's facility, unless the decision is approved by the Contracting Officer.

(b) The Contractor shall incorporate this clause, including this paragraph (b), in all solicitations and contracts exceeding the simplified acquisition threshold in part 13 of the Federal Acquisition Regulation, except those for commercial items.

(End of clause)

252.209-7004 SUBCONTRACTING WITH FIRMS THAT ARE OWNED OR CONTROLLED BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) Unless the Government determines that there is a compelling reason to do so, the Contractor shall not enter into any subcontract in excess of $25,000 with a firm, or subsidiary of a firm, that is identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country.

(b) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country. The notice must include the name of the proposed subcontractor notwithstanding its inclusion on the List of Parties Excluded From Federal Procurement and Nonprocurement Programs.

(End of clause)

252.219-7003 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DOD CONTRACTS) (APR. 1996)

This clause supplements the Federal Acquisition Regulation 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, clause of this contract.

(a) *Definitions. Historically black colleges and universities,* as used in this clause, means institutions determined by the Secretary of Education to meet the requirements of 34 CFR 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.

Minority institutions, as used in this clause, means institutions meeting the requirements of section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1135d-5(3)). The term also includes Hispanic-serving institutions as defined in section 316(b)(1) of such Act (20 U.S.C. 1059c(b)(1)).

(b) Except for company or division-wide commercial items subcontracting plans, the term *small disadvantaged business,* when used in the FAR 52.219-9 clause, includes historically black colleges and universities and minority institutions, in addition to small disadvantaged business concerns.

(c) Work under the contract or its subcontracts shall be credited toward meeting the small disadvantaged business concern goal required by paragraph (d) of the FAR 52.219-9 clause when:

(1) It is performed on Indian lands or in joint venture with an Indian tribe or a tribally-owned corporation, and

(2) It meets the requirements of 10 U.S.C. 2323a.

(d) Subcontracts awarded to workshops approved by the Committee for Purchase from People Who are Blind or Severely Disabled (41 U.S.C. 46-48), may be counted toward the Contractor's small business subcontracting goal.

(e) A mentor firm, under the Pilot Mentor-Protege Program established under Section 831 of Pub. L. 101-510, as amended, may count toward its small disadvantaged business goal, subcontracts awarded--

(f) The master plan approval referred to in paragraph (f) of the FAR 52.219-9 clause is approval by the Contractor's cognizant contract administration activity.

(g) In those subcontracting plans which specifically identify small, small disadvantaged, and women-owned small businesses, the Contractor shall notify the Administrative Contracting Officer of any substitutions of firms that are not small, small disadvantaged, or women-owned small businesses for the firms listed in the subcontracting plan. Notifications shall be in writing and shall occur within a reasonable period of time after award of the subcontract. Contractor-specified formats shall be acceptable.

(End of clause)

252.223-7004 DRUG-FREE WORK FORCE (SEP 1988)

(a) Definitions.

(1) "Employee in a sensitive position," as used in this clause, means an employee who has been granted access to classified information; or employees in other positions that the Contractor determines involve national security; health or safety, or functions other than the foregoing requiring a high degree of trust and confidence.

(2) "Illegal drugs," as used in this clause, means controlled substances included in Schedules I and II, as defined by section 802(6) of title 21 of the United States Code, the possession of which is unlawful under chapter 13 of that Title. The term "illegal drugs" does not mean the use of a controlled substance pursuant to a valid prescription or other uses authorized by law.

(b) The Contractor agrees to institute and maintain a program for achieving the objective of a drug-free work force. While this clause defines criteria for such a program, contractors are encouraged to implement alternative approaches comparable to the criteria in paragraph (c) that are designed to achieve the objectives of this clause.

(c) Contractor programs shall include the following, or appropriate alternatives:

(1) Employee assistance programs emphasizing high level direction, education, counseling, rehabilitation, and coordination with available community resources;

(2) Supervisory training to assist in identifying and addressing illegal drug use by Contractor employees;

(3) Provision for self-referrals as well as supervisory referrals to treatment with maximum respect for individual confidentiality consistent with safety and security issues;

(4) Provision for identifying illegal drug users, including testing on a controlled and carefully monitored basis. Employee drug testing programs shall be established taking account of the following:

(i) The Contractor shall establish a program that provides for testing for the use of illegal drugs by employees in sensitive positions. The extent of and criteria for such testing shall be determined by the Contractor based on considerations that include the nature of the work being performed under the contract, the employee's duties, and efficient use of Contractor resources, and the risks to health, safety, or national security that could result from the failure of an employee adequately to discharge his or her position.

(ii) In addition, the Contractor may establish a program for employee drug testing--

(A) When there is a reasonable suspicion that an employee uses illegal drugs; or

(B) When an employees has been involved in an accident or unsafe practice;

(C) As part of or as a follow-up to counseling or rehabilitation for illegal drug use;

(D) As part of a voluntary employee drug testing program.

(iii) The Contractor may establish a program to test applicants for employment for illegal drug use.

(iv) For the purpose of administering this clause, testing for illegal drugs may be limited to those substances for which testing is prescribed by section 2..1 of subpart B of the "Mandatory Guidelines for Federal Workplace Drug Testing Programs" (53 FR 11980 (April 11, 1988), issued by the Department of Health and Human Services.

(d) Contractors shall adopt appropriate personnel procedures to deal with employees who are found to be using drugs illegally. Contractors shall not allow any employee to remain on duty or perform in a sensitive position who is found to use illegal drugs until such times as the Contractor, in accordance with procedures established by the Contractor, determines that the employee may perform in such a position.

(e) The provisions of this clause pertaining to drug testing program shall not apply to the extent that are inconsistent with state or local law, or with an existing collective bargaining agreement; provided that with respect to the latter, the

Contractor agrees those issues that are in conflict will be a subject of negotiation at the next collective bargaining session.

(End of clause)

252.223-7006 PROHIBITION ON STORAGE AND DISPOSAL OF TOXIC AND HAZARDOUS MATERIALS (APR 1993)

(a) "Definitions".

As used in this clause --

(1) "Storage" means a non-transitory, semi-permanent or permanent holding, placement, or leaving of material. It does not include a temporary accumulation of a limited quantity of a material used in or a waste generated or resulting from authorized activities, such as servicing, maintenance, or repair of Department of Defense (DoD) items, equipment, or facilities.

(2) "Toxic or hazardous materials" means:

(i) Materials referred to in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601(14)) and materials designated under section 102 of CERCLA (42 U.S.C. 9602) (40 CFR part 302);

(ii) Materials that are of an explosive, flammable, or pyrotechnic nature; or

(iii) Materials otherwise identified by the Secretary of Defense as specified in DoD regulations.

(b) In accordance with 10 U.S.C. 2692, the Contractor is prohibited from storing or disposing of non-DoD-owned toxic or hazardous materials on a DoD installation, except to the extent authorized by a statutory exception to 10 U.S.C. 2692 or as authorized by the Secretary of Defense or his designee.

(End of clause)

252.226-7001 UTILIZATION OF INDIAN ORGANIZATIONS AND INDIAN-OWNED ECONOMIC ENTERPRISES-DOD CONTRACTS (SEP 2001)

(a) Definitions. As used in this clause--

“Indian” means any person who is a member of any Indian tribe, band, group, pueblo, or community that is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs (BIA) in accordance with 25 U.S.C. 1452(c) and any “Native” as defined in the Alaska Native Claims Settlement Act (43 U.S.C. 1601).

“Indian organization” means the governing body of any Indian tribe or entity established or recognized by the governing body of an Indian tribe for the purposes of 25 U.S.C. Chapter 17.

“Indian-owned economic enterprise” means any Indian-owned (as determined by the Secretary of the Interior) commercial, industrial, or business activity established or organized for the purpose of profit, provided that Indian ownership constitutes not less than 51 percent of the enterprise.

“Indian tribe” means any Indian tribe, band, group, pueblo, or community, including native villages and native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native

Claims Settlement Act, that is recognized by the Federal Government as eligible for services from BIA in accordance with 25 U.S.C. 1452 (c).

“Interested party” means a contractor or an actual or prospective offeror whose direct economic interest would be affected by the award of a subcontract or by the failure to award a subcontract.

(b) The Contract shall use its best efforts to give Indian organizations and Indian-owned economic enterprises the maximum practicable opportunity to participate in the subcontracts it awards, to the fullest extent consistent with efficient performance of the contract.

(c) The Contracting Officer and the Contractor, acting in good faith, may rely on the representation of an Indian organization or Indian-owned economic enterprise as to its eligibility, unless and interested party challenges its status or the Contracting Officer has independent reason to question that status.

(d) In the event of a challenge to the representation of a subcontractor, the Contracting Officer will refer the matter to the U.S. Department of the Interior, Bureau of Indian Affairs, Attn: Chief, Division of Contracting and Grants Administration, 1849 C Street NW, MS-2626-MIB, Washington, DC 20240-4000. The BIA will determine the eligibility and will notify the Contracting Officer. No incentive payment will be made--

(1) Within 59 working days of subcontract award;

(2) While a challenge is pending; or

(3) If a subcontractor is determined to be an ineligible participant.

(e)(1) The Contractor, on its own behalf or on behalf of a subcontractor at any tier, may request an adjustment under the Indian Incentive Program to the following:

(i) The estimated cost of cost-type contract.

(ii) The target cost of a cost-plus-incentive-fee contract.

(iii) The target cost and ceiling price of a fixed-price incentive contract.

(iv) The price of a firm-fixed-price contract.

(2) The amount of the adjustment that may be made to the contract is 5 percent of the estimated cost, target cost, or firm-fixed price included in the subcontract initially awarded to the Indian organization or Indian-owned economic enterprise.

(3) The Contractor has the burden of proving the amount claimed and must assert its request for an adjustment prior to completion of contract performance.

(4) The Contracting Officer, subject to the terms and conditions of the contract and the availability of funds, will authorize an incentive payment of 5 percent of the amount paid to the subcontractor.

(5) If the Contractor requests and receives an adjustment on behalf of a subcontractor, the Contractor is obligated to pay the subcontractor the adjustment.

(f) The Contractor shall insert the substance of this clause, including this paragraph (f), in all subcontracts that--

(1) Are for other than commercial items; and

(2) Are expected to exceed the simplified acquisition threshold in Part 2 of the Federal Acquisition Regulation.

(End of clause)

252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)

(a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.

252.236-7000 MODIFICATION PROPOSALS - PRICE BREAKDOWN. (DEC 1991)

(a) The Contractor shall furnish a price breakdown, itemized as required and within the time specified by the Contracting Officer, with any proposal for a contract modification.

(b) The price breakdown --

(1) Must include sufficient detail to permit an analysis of profit, and of all costs for --

(i) Material;

(ii) Labor;

(iii) Equipment;

(iv) Subcontracts; and

(v) Overhead; and

(2) Must cover all work involved in the modification, whether the work was deleted, added, or changed.

(c) The Contractor shall provide similar price breakdowns to support any amounts claimed for subcontracts.

(d) The Contractor's proposal shall include a justification for any time extension proposed.

252.242-7000 POSTAWARD CONFERENCE (DEC 1991)

The Contractor agrees to attend any postaward conference convened by the contracting activity or contract administration office in accordance with Federal Acquisition Regulation subpart 42.5.

(End of clause)

252.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)

When costs are a factor in any price adjustment under this contract, the contract cost principles and procedures in FAR part 31 and DFARS part 231, in effect on the date of this contract, apply.

252.243-7002 REQUESTS FOR EQUITABLE ADJUSTMENT (MAR 1998)

(a) The amount of any request for equitable adjustment to contract terms shall accurately reflect the contract adjustment for which the Contractor believes the Government is liable. The request shall include only costs for performing the change, and shall not include any costs that already have been reimbursed or that have been separately claimed. All indirect costs included in the request shall be properly allocable to the change in accordance with applicable acquisition regulations.

(b) In accordance with 10 U.S.C. 2410(a), any request for equitable adjustment to contract terms that exceeds the simplified acquisition threshold shall bear, at the time of submission, the following certificate executed by an individual authorized to certify the request on behalf of the Contractor:

I certify that the request is made in good faith, and that the supporting data are accurate and complete to the best of my knowledge and belief.

(Official's Name)

(Title)

(c) The certification in paragraph (b) of this clause requires full disclosure of all relevant facts, including--

(1) Cost or pricing data if required in accordance with subsection 15.403-4 of the Federal Acquisition Regulation (FAR); and

(2) Information other than cost or pricing data, in accordance with subsection 15.403-3 of the FAR, including actual cost data and data to support any estimated costs, even if cost or pricing data are not required.

(d) The certification requirement in paragraph (b) of this clause does not apply to----

(1) Requests for routine contract payments; for example, requests for payment for accepted supplies and services, routine vouchers under a cost-reimbursement type contract, or progress payment invoices; or

(2) Final adjustment under an incentive provision of the contract.

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SECTION 00800

SPECIAL CLAUSES

05/02

PART 1 GENERAL

1.1 REFERENCES - NOT USED

1.2 SUBMITTALS

Government approval/acceptance is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Small Tool Usage Plan

Labor, Equipment and Material Reports; G, RE

Quality Control Plan; G, RE

SD-05 Design Data

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Maintenance and Parts Data

SF1413

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Construction and Demolition (C&D) Waste Management Plan; G, RE

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DA Form 3337; G, RE

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As-Built Drawings; G, RE

Mechanical Room Layout; G, RE

1.3 COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK (APR 1984) FAR 52.211-10.
2 Jan 96

The Contractor shall be required to commence work under this contract within 10 calendar days after the date the Contractor receives the notice to proceed, prosecute said work diligently, and complete the entire work ready for use not later than 660 calendar days after date of receipt of notice to proceed. The time stated for completion shall include as-built drawings, O&M manuals, operational tests/reports/training/instructions, equipment lists, and final cleanup of the premises.

1.4 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000) FAR 52.211-12.
Oct 00

a. If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of $1500 for each calendar day of delay until the work is completed or accepted.

b. If the Government terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause.

1.5 NOT USED
Oct 00
1.6 NOT USED

1.7 CONTRACT DRAWINGS AND SPECIFICATIONS (AUG 2000) DFARS 252.236-7001
19 Sept 2000

a. At award, the Government will furnish the Contractor a compact disk containing all technical contract documents. This disk will include a complete set of drawing files and technical specification files which have all amendments incorporated. The disk will contain drawing files in CALS Type 4 format and technical specifications in PDF format.

The CALS files and the PDF files are being provided for the Contractor's use in printing hard copies of contract documents.

In addition, native CADD files and Specsintact files are provided in accordance with "AS-BUILT DOCUMENTS" paragraph for the Contractor's use in developing as-built plans and specifications.

b. The Contractor shall--

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies;

(4) Be responsible for any errors which might have been avoided by complying with paragraph (b); and

(5) Reproduce and print contract drawings and specifications as needed.

c. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or that are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work. The Contractor shall perform such details as if fully and correctly set forth and described in the drawings and specifications.

d. The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

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1P1.2.1	SECOND FLOOR PLAN - PLUMBING
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1P7.1	KITCHEN PLAN AND NOTES
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1LS1.1	ENLARGED LIFE SAFETY FIRST FLOOR PLAN
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1FP1.1	FIRST FLOOR PLAN FIRE SUPPRESSION
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1E1.1.1	PARTIAL FIRST FLOOR PLAN - LIGHTING
1E1.1.2	PARTIAL FIRST FLOOR PLAN - LIGHTING
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1E1.2.1	SECOND FLOOR PLAN - LIGHTING
1E2.1.1	PARTIAL FIRST FLOOR PLAN - POWER
1E2.1.2	PARTIAL FIRST FLOOR PLAN - POWER
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1E2.1.4	PARTIAL FIRST FLOOR PLAN - FAN COIL POWER
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1E3.1.2	PARTIAL FIRST FLOOR PLAN - SIGNAL
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1E4.1	LIGHTNING PROTECTION PLAN
1E5.1	LIGHTING SCHEDULE AND DETAILS
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2P1.1.1	FLOOR PLAN - PLUMBING
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LIFE SAFETY

2LS0.0	LIFE SAFETY - CODE REVIEW
2LS1.1	LIFE SAFETY FLOOR PLAN

FIRE PROTECTION

2FP1.1	FLOOR PLAN - FIRE SUPPRESSION

ELECTRICAL

2E1.1	FLOOR PLAN - LIGHTING, POWER AND SIGNAL
2E4.1	ROOF PLAN - LIGHTNING PROTECTION
2E7.1	POWER ONE-LINE & FIRE ALARM RISER
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3S1.1	FOUNDATION / FLOOR SLAB PLAN, SECTIONS & DETAILS
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4S1.1	LOADING RAMP PLAN AND SECTIONS
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1.8 AS-BUILT DOCUMENTS

3 November 1998 (Version 1)

1.8.1 General.

This section covers the completion of as-built drawings and as-built specifications, as a requirement of the contract.

1.8.1.1 As-Built Drawings

An as-built drawing is a construction drawing revised to reflect the final as-built conditions of the project because of modifications, changes, corrections to the project design required during construction, submittals and extensions of design. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings that are revised to be used for the "RECORD DRAWING AS-BUILTS".

1.8.1.2 As-Built Specifications:

As-built specifications are the construction specifications as modified by changes (contract mods, ACO approved variations from the construction specifications which did not result in contract mods).

1.8.2 Maintenance of Working As-Built Drawings

The Contractor shall revise 2 sets of paper prints by red-line process to show the as-built conditions during the prosecution of the project. These

as-built marked prints shall be kept current on a weekly basis and available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Changes must be reflected on all sheets affected by the change. The working as-built marked prints will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor before submission of each monthly pay estimate. The working as-built drawings shall show the following information, but not be limited thereto:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Additional as-built information that exceeds the detail shown on the Contract Drawings. These as-built conditions include those that reflect structural details, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations and layouts, equipment, sizes, mechanical room layouts and other extensions of design, that were not shown in the original contract documents because the exact details were not known until after the time of approved shop drawings. It is recognized that these shop drawing submittals (revised showing as-built conditions) will serve as the as-built record without actual incorporation into the contract drawings. All such shop drawing submittals must include, along with the hard copy of the drawings, CADD files of the shop drawings in a commercially available digital format, compatible with the Using Agency System (see paragraph "Computer Aided Design and Drafting (CADD) Drawings"). All shop drawings which require submittal of CADD files are indicated in the submittal register located at the end of this section.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government

property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. If fire protection and fire detection related systems are included in this project, the as-built drawings will include detailed information for all aspects of the systems including wiring, piping, and equipment drawings.

The Contractor will be provided files at the beginning of construction for use during the construction phase which are to be maintained during construction and for the preparation of as-builts. The Contractor shall enter changes and corrections on blue line prints on a weekly basis in accordance with Paragraph "Maintenance of Working As-Built Drawings" and update the CADD as-built drawings on a weekly basis. Both paper and electronic documents shall be available at all times and shall be provided promptly to the Contracting Officer when requested. The Contractor shall be responsible for backup of electronic files during construction and for controlling release of information.

1.8.3 Retainage

The Contractor shall include in his schedule of values, the cost of as-built document preparation. This value shall include all requirements of this clause:

Maintenance of working as-built drawings
Maintenance of working as-built specifications
Conversion of submittals and other miscellaneous documents into electronic files
Creation of "Record As-Built Drawings & Specifications" (either by CADD dwgs and Specsintact specifications or by manually prepared documents as specified herein.)
Creation of a CD containing all required files.
Submittal of as-built documents in the required media forms and numbers of copies

If the Contractor fails to maintain the working as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of bringing the as-built documents up to date. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of working as-built documents.

1.8.4 Preliminary Submittal

Six (6) weeks before occupancy of this facility by the Government, the Contractor shall submit one (1) set of the original working as-built drawings to the Contracting Officer for review and approval. These working as-built marked drawings shall be neat, legible and accurate. The review by Government personnel will be expedited to the maximum extent possible. Upon approval, the working as-built marked drawings will be returned to the Contractor for use in preparation of final as-built drawings. If upon

review, the working as-built marked drawings are found to contain errors and/or omissions, they will be returned to the Contractor for corrections. The Contractor shall complete the corrections and return the working as-built marked drawings to the Contracting Officer within 10 calendar days.

1.8.5 Preparation of Final As-Built Drawings

Upon approval of the working as-built prints submittal, the Contractor will be furnished, by the Government, one set of contract drawings in CADD (if not previously provided) with all amendments incorporated, to be used for final as-built drawings. These contract drawings will be furnished in the format specified in paragraph "Computer Aided Design and Drafting" (CADD). These drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, adding such additional drawings as may be necessary. These drawings are part of the permanent records of this project and the Contractor shall be responsible for the protection and safety thereof until returned to the Contracting Officer. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

In the event the Contractor accomplishes additional work which changes the as-built conditions of the facility, after submission and approval of the working as-built drawings, he shall be responsible for the addition of these changes to the working as-built drawings and also to the final as-built documents.

1.8.6 Markings and Indicators

Changes shall be annotated with a triangle and sequential number at the following locations:

a. bottom of the revised detail
b. right hand and bottom border aligned with the revised detail
c. the revision block of the title block.

Separate markings shall be made for each modification negotiated into the contract.

1.8.7 Preparation of Final As-Built Specifications

Final as-built specifications shall be prepared in Specsintact and the electronic files shall be placed on the same CD-ROM that contains the as-built CADD files, if applicable. The front sheet of the specifications shall contain an identification which clearly labels the specifications as representing as-built conditions and shall be dated with the date of the submittal.

1.8.8 Preparation of Other As-Built Documents

All other non-electronic documents which may include design analysis, catalog cuts, certification documents that are not available in native electronic format shall be scanned and provided in an organized manner in Adobe .pdf format.

1.8.9 Submittal of Final As-Built Documents

At the time of Beneficial Occupancy of the project, Final As-Built documents shall be provided to the Contracting Officer in the formats described in paragraph "Computer Aided Design and Drafting (CADD)".

1.8.10 Partial Occupancy

For projects where portions of construction are to be occupied or activated before overall project completion, including portions of utility systems, as-built drawings for those portions of the facility being occupied or activated shall be supplied at the time the facility is occupied or activated. This same as-built information previously furnished must also be shown on the final set of as-built drawings at project completion.

1.8.11 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality to that of the originals. Line work, line weights, lettering, layering conventions, and symbols shall be the same as the original line work, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same guidance specified for original drawings. Three dimensional (3D) elements shall be placed in files in their proper locations when using 3D files with spatially correct elements. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD media files supplied by the Government. All work by the Contractor shall be done on files in the format in which they are provided. Translation of files to a different format, for the purpose of As-Built production, and then retranslating back to the format originally provided, will not be acceptable. These contract drawings will already be compatible with the Using Agency's system when received by the Contractor. The Using Agency uses Microstation J CADD software system. The media files will be supplied by the Contractor to the COR on ISO 9660 Format CD-ROM. The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make all required corrections, changes, additions, and deletions.

a. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-BUILT" drawing denoting no revisions on the sheet or "REVISED AS-BUILT" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

b. Revision markers defined in paragraph "Markings and Indicators" shall be placed as follows:

(1) at the detail, placed in the design file where the revised graphics are located and the revision was placed

(2) right hand and bottom border in the drawing sheet file revision block of the title block in the drawing sheet file.

c. After receipt by the Contractor of the approved working as-built prints and the original contract drawings files the Contractor shall, within 60 calendar days, make the final as-built submittal. This submittal shall consist of 2 sets of completed final as-built drawings on separate media consisting of both CADD files (compatible with the Using Agency's system on electronic storage media identical to that supplied by the Government) and Mylars; 2 blue line prints of these drawings and the return of the approved marked working as-built prints. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with its CADD system. All paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.8.12 NOT USED

1.8.13 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs in conjunction therewith, shall be considered a subsidiary obligation of the Contractor.

1.9 NOT USED

1.10 EQUIPMENT DATA
15 June 1990

Real Property Equipment.

Contractor shall be required to make an Equipment-in-Place list of all installed equipment furnished under this contract. This list shall include all information usually listed on manufacturer's name plate. The form is part of SPECIAL CLAUSES and is included following the SPECIAL CLAUSES, so to positively identify the piece of property. The list shall also include the cost of each piece of installed property F.O.B. construction site. For each of the items which is specified herein to be guaranteed for a specified period from the date of acceptance thereof, the following information shall be given: The name, serial and model number address of equipment supplier, or manufacturer originating the guaranteed item. The

Contractor's guarantee to the Government of these items will not be limited by the terms of any manufacturer's guarantee to the Contractor. Furnish the list as one (1) reproducible and three (3) copies to the Contracting Officer thirty (30) calendar days before completion of any segment of the contract work which has an incremental completion date.

Maintenance and Parts Data.

The Contractor will be required to furnish a brochure, catalog cut, parts list, manufacturer's data sheet or other publication which will show detailed parts data on all other equipment subject to repair and maintenance procedures not otherwise required in Operations and Maintenance Manuals specified elsewhere in this contract. Distribution of directives shall follow the same requirements as listed in paragraph above.

1.11 PHYSICAL DATA (APR 1984) FAR 52.236-4.
2 January 1996

Data and information furnished or referred to below is furnished for the Contractor's information. The Government will not be responsible for any interpretation or conclusion drawn from the data or information by the Contractor.

Physical Conditions indicated on the drawings and in the specifications are the result of site investigations by surveys, borings, test pits and probings.

Weather Conditions. The Contractor shall make his own investigations as to weather conditions at the site. Data may be obtained from various National Weather Service offices located generally at airports of principal cities, the nearest to this project being: Syracuse, NY

Historical data for all areas may be obtained from:

U. S. Department of Commerce
National Climatic Center
Federal Building
Asheville, N. C. 28801

Transportation Facilities. Roads and railroads in the general area are shown on the drawings. Access ways shall be investigated by the Contractor to satisfy himself as to their existence and allowable use.

1.12 UTILITIES (APR 1984) FAR 52.236-14 (Para. 1.12.a.(1) & 1.12.a.(2) only).
15 June 1990

a. Availability and Use of Utility Services

(1) The Government will make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where

the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

(2) The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

b. Alterations to Utilities

Where changes and relocations of utility lines are noted to be performed by others, the Contractor shall give the Contracting Officer at least thirty (30) days written notice in advance of the time that the change or relocation is required. In the event that, after the expiration of thirty (30) days after the receipt of such notice by the Contracting Officer, such utility lines have not been changed or relocated and delay is occasioned to the completion of the work under contract, the Contractor will be entitled to a time extension equal to the period of time lost by the Contractor after the expiration of said thirty (30) day period. Any modification to existing or relocated lines required as a result of the Contractor's method of operation shall be made wholly at the Contractor's expense and no additional time will be allowed for delays incurred by such modifications.

c. Interruptions of Utilities

(1) No utility services shall be interrupted by the Contractor to make connections, to relocate, or for any purpose without approval of the Contracting Officer.

(2) Request for Permission to shut down services shall be submitted in writing to the Contracting Officer not less than seventeen (17) days before date of proposed interruption. The request shall give the following information:

(a) Nature of Utility (Gas, L.P. or H.P., Water, etc.)

(b) Size of line and location of shutoff;

(c) Buildings and services affected.

(d) Hours and date of shutoff.

(e) Estimated length of time services will be interrupted.

(3) Services shall not be shutoff until receipt of approval of the proposed hours and date from the Contracting Officer.

(4) Shutoffs which will cause interruption of Government work operations as determined by the Contracting Officer shall be accomplished during regular non-work hours or on non-work days of the Using Agency

without any additional cost to the Government.

(5) Operation of valves on water mains will be by Government personnel. Where shutoff of water lines interrupts service to fire hydrants or fire sprinkler systems, the Contractor shall arrange his operations and have sufficient material and personnel available to complete the work without undue delay or to restore service without delay in event of emergency.

(6) Flow in gas mains which have been shut off shall not be restored until the Government inspector has determined that all items serviced by the gas line have been shut off.

1.13 NOT USED

1.14 LAYOUT OF WORK (APR 1984) FAR 52.236-17
15 June 1990 **(Version 1)**

The Contractor shall lay out its work from Government-established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at his own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

1.15 NOT USED

1.16 PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984) FAR 52.236-1
15 June 1990

The Contractor shall perform on the site, and with its own organization, work equivalent to at least 20 percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

a. For purposes of this paragraph "WORK BY THE CONTRACTOR" is defined as prime Contractor direct contract labor (including testing and layout personnel), exclusive of other general condition or field overhead personnel, material, equipment, or subcontractors. The "TOTAL AMOUNT OF WORK" is defined as total direct contract labor (including testing and layout personnel), exclusive of other general condition or field overhead personnel, material, or equipment.

b. Within 7 days after the award of any subcontract, either by himself or a subcontractor, the Contractor shall deliver to the Contracting

Officer a completed SF 1413, "Statement and Acknowledgment." The form shall include the subcontractor's acknowledgement of the inclusion in his subcontract of the clauses of this contract entitled "Davis-Bacon Act," "Contract Work Hours and Safety Standards Act-Overtime Compensation," "Apprentices and Trainees," "Compliance with Copeland Regulations," "Withholding of Funds," "Subcontracts," "Contract Termination-Debarment," and "Payrolls and Basic Records." Nothing contained in this contract shall create any contractual relation between the subcontractor and the Government.

1.17 SUPERINTENDENCE OF SUBCONTRACTORS
24 February 1992

a. The Contractor shall be required to furnish the following, in addition to the superintendence required by CONTRACT CLAUSE: SUPERINTENDENCE BY THE CONTRACTOR.

(1) If more than 50 percent and less than 70 percent of the value of the contract work is subcontracted, one superintendent shall be provided at the site and on the Contractor's payroll to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

(2) If 70 percent or more of the value of the work is subcontracted, the Contractor shall be required to furnish two such superintendents to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

b. If the Contracting Officer, at any time after 50 percent of the subcontracted work has been completed, finds that satisfactory progress is being made, he may waive all or part of the above requirements for additional superintendence subject to the right of the Contracting Officer to reinstate such requirement if at any time during the progress of the remaining work he finds that satisfactory progress is not being made.

1.18 IDENTIFICATION OF EMPLOYEES.
15 June 1990

a. The Contractor shall be responsible for furnishing an identification badge/card to each employee prior to the employees work on-site, and for requiring each employee engaged on the work to display identification as may be approved and directed by the Contracting Officer. All prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of the employee. When required by the Contracting Officer, the Contractor shall obtain and submit fingerprints of all persons employed or to be employed on the project.

b. The Contractor is required to provide a Local Agency Check for each individual that will be working on this contract. See Paragraph "COMPLIANCE WITH POST/BASE REGULATIONS" for instructions.

1.19 NOT USED

1.20 WARRANTY OF CONSTRUCTION (MAR 1994) ALTERNATE 1 (APR 1984) FAR 52.246-21I.

15 January 1998

a. General Requirements

(1) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph 1.20.a.(9) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(2) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(a) As a part of the one year warranty inspection, the Contracting Officer will conduct an infrared roof survey on any project involving a membrane roofing system. This survey will be conducted in accordance with ASTM C1153-90, "Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging". In accordance with paragraph 1.20.a.(3) and 1.20.a.(4) below, the Contractor shall be required to replace all damaged materials and to locate and repair sources of moisture penetration.

(3) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(a) The Contractor's failure to conform to contract requirements; or

(b) Any defect of equipment, material, workmanship, or design furnished.

(4) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

(5) The Contracting Officer shall notify the Contractor, in writing, (see para. 1.20.b.(3) and 1.20.e) within a reasonable time after the discovery of any failure, defect, or damage.

(6) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, (see para. 1.20.5) the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(7) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(a) Obtain all warranties that would be given in normal commercial practice;

(b) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(c) Provide names, addresses, and telephone numbers of all subcontractors, equipment suppliers, or manufacturers with specific designation of their area of responsibilities if they are to be contacted directly on warranty corrections; and

(d) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(8) In the event the Contractor's warranty under paragraph of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(9) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

(10) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

(11) Defects in design or manufacture of equipment specified by the Government on a "brand name and model" basis, shall not be included in this warranty. In this event, the Contractor shall require any subcontractors, manufacturers, or suppliers thereof to execute their warranties, in writing, directly to the Government.

b. Performance Bond

(1) The Contractor's Performance Bond will remain effective throughout the construction warranty period and warranty extensions.

(2) In the event the Contractor or his designated representative(s) fails to commence and diligently pursue any work required under this clause, and in a manner pursuant to the requirements thereof, the Contracting Officer shall have a right to demand that said work be performed under the Performance Bond by making written notice on the surety. If the surety fails or refuses to perform the obligation it assumed under the Performance Bond, the Contracting Officer shall have the work performed by others, and after completion of the work, may make demand for reimbursement of any or all expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

(3) Following oral or written notification of required warranty repair work, the Contractor will respond as dictated by para. 1.20.e. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the

Contractor as outlined in the paragraph 1.20.b.(2) above.

c. Pre-Warranty Conference

Prior to contract completion and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this clause. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warrantied construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of his responsibilities in connection with other portions of this provision.

d. Equipment Warranty Identification Tags

(1) The Contractor shall provide warranty identification tags on all Contractor and Government furnished equipment which he has installed.

(a) The tags shall be similar in format and size to the exhibits provided by this specification, they shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure-sensitive adhesive back, and they shall be installed in a position that is easily (or most easily) noticeable. Contractor furnished equipment that has differing warranties on its components will have each component tagged.

(b) Sample tags shall be submitted for Government review and approval. These tags shall be filled out representative of how the Contractor will complete all other tags.

(c) Tags for Warrantied Equipment: The tag for this equipment shall be similar to the following. Exact format and size will be as approved.

EQUIPMENT WARRANTY
CONTRACTOR FURNISHED EQUIPMENT

MFG MODEL NO.

SERIAL NO.

CONTRACT NO.

CONTRACTOR NAME

CONTRACTOR WARRANTY EXPIRES

MFG WARRANTY(IES) EXPIRE

EQUIPMENT WARRANTY
GOVERNMENT FURNISHED EQUIPMENT

MFG MODEL NO.

SERIAL NO.

CONTRACT NO.

DATE EQUIP PLACED IN SERVICE

MFG WARRANTY(IES) EXPIRE

(d) If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag. The Contractor warranty expires (warranty expiration date) and the final manufacturer's warranty expiration date will be determined as specified by para. 1.20.1.

(2) Execution. The Contractor will complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment.

(3) Payment. The work outlined above is a subsidiary portion of the contract work, and has a value to the Government approximating 5% of the value of the Contractor furnished equipment. The Contractor will assign a value of that amount in the breakdown for progress payments mentioned in the Contract Clause: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS.

(4) Equipment Warranty Tag Replacement. As stated in para. 1.20.1.4, the Contractor's warranty with respect to work repaired or replaced shall run for one year from the date of repair or replacement. Such activity shall include an updated warranty identification tag on the repaired or replaced equipment. The tag shall be furnished and installed by the Contractor, and shall be identical to the original tag, except that the Contractor's warranty expiration date will be one year from the date of acceptance of the repair or replacement.

e. Contractor's Response to Warranty Service Requirements. Following oral or written notification by the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, the Contractor shall respond to warranty service requirements in accordance with the "Warranty Service Priority List" and the three

categories of priorities listed below.

First Priority Code 1 Perform on site inspection to evaluate situation, determine course of action, initiate work within 24 hours and work continuously to completion or relief.

Second Priority Code 2 Perform on site inspection to evaluate situation, determine course of action, initiate work within 48 hours and work continuously to completion or relief.

Third Priority Code 3 All other work to be initiated within 5 work days and work continuously to completion or relief.

The "Warranty Service Priority List" is as follows:

Code 1 Air Conditioning System
- a. Buildings with computer equipment.

Code 2 Air Conditioning Systems
- a. Air conditioning leak in part of building, if causing damage.
- b. Admin buildings with ADP equipment not on priority list.

Code 1 Doors
- a. Overhead doors not operational.

Code 1 Electrical
- a. Power failure (entire area or any building operational after 1600 hours).
- b. Security lights.

Code 2 Electrical
- a. Power failure (no power to a room or part of building).
- b. Receptacle and lights.
- c. Fire alarm systems.

Code 1 Gas
- a. Leaks and breaks.

Code 1 Heat
- a. Area power failure affecting heat.

Code 2 Heat
- a. Medical storage.

Code 1 Intrusion Detection Systems
Finance, PX and Commissary, and high security areas.

Code 2 Intrusion Detection Systems
Systems other than those listed under Code 1.

Code 1 Kitchen Equipment
- a. Dishwasher.

b. All other equipment hampering preparation of a meal.

Code 2 Kitchen Equipment
All other equipment not listed under Code 1.

Code 2 Plumbing
a. Flush valves.
b. Fixture drain, supply line commode, or water pipe leaking.
c. Commode leaking at base.

Code 1 Refrigeration
a. Cold Storage.

Code 2 Refrigeration
Mess hall - other than walk-in refrigerators and freezers.

Code 1 Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2 Roof Leaks
Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 1 Water (Exterior)
Normal operation of water pump station.

Code 2 Water (Exterior)
No water to facility.

Code 1 Water, Hot (and Steam)
a. Medical and dental.

Code 2 Water, Hot
No hot water in portion of building listed under Code 1 (items a through c).

Code 1 Sprinkler System
All sprinkler systems, valves, manholes, deluge systems, and air systems to sprinklers.

(1) Should parts be required to complete the work and the parts are not immediately available, the Contractor shall have a maximum of 12 hours after arrival at the job site to provide the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, with firm written proposals for emergency alternatives and temporary repairs for Government participation with the Contractor to provide emergency relief until the required parts are available on site for the Contractor to perform permanent warranty repair. The Contractors proposals shall include a firm date and time that the required parts shall be available on site to complete the permanent warranty repair. The

Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer, will evaluate the proposed alternatives and negotiate the alternative considered to be in the best interest of the Government to reduce the impact of the emergency condition. Alternatives considered by the Contracting Officer or an authorized representative of the installation designated in writing by the Contracting Officer will include the alternative for the Contractor to "Do Nothing" while waiting until the required parts are available to perform permanent warranty repair. Negotiating a proposal which will require Government participation and the expenditure of Government funds shall constitute a separate procurement action by the using service.

1.21 NOT USED

1.22 NOT USED

1.23 NOT USED

1.24 IDENTIFICATION OF GOVERNMENT-FURNISHED PROPERTY (APR 1984) FAR 52.245-3.
2 January 1991

a. The Government will furnish to the Contractor the property identified in the Schedule to be incorporated or installed into the work or used in performing the contract. The listed property will be furnished at the place specified below. When the property is delivered, the Contractor shall verify its quantity and condition and acknowledge receipt in writing to the Contracting Officer. The Contractor shall also report in writing to the Contracting Officer within 24 hours of delivery any damage to or shortage of the property as received. All such property shall be installed or incorporated into the work at the expense of the Contractor, unless otherwise indicated in this contract.

Location of GFP:

f.o.b. truck at the project site.

b. The Contractor is required to accept delivery, pay any demurrage or detention charges, and unload and transport the property to the jobsite at its own expense.

c. Each item of property to be furnished under this clause shall be identified in the Schedule by quantity, item, and description.

Quantity	Item	Description
1	Plaque	Minuteman

1.25 NOT USED

1.26 PROJECT SIGN
1 August 1996

General. The Contractor shall furnish and erect at the location directed

one project sign.

Exact placement location will be designated by the Contracting Officer. The panel sizes and graphic formats have been standardized for visual consistency throughout all Corps operations.

Panels are fabricated using HDO plywood with dimensional lumber uprights and bracing.

All legends are to be painted in the sizes and styles as specified by the graphic formats shown at the end of this section. The signs (including back and edges), posts and braces shall be given two coats of Benjamin Moore No. 120-60 poly-silicone enamel or approved equal before lettering. The 4' x 4' right section of the project sign shall be white with black lettering. The upper 2' x 2' left section of the project sign shall be communication red (CR) with white lettering. The lower 2' x 2' left section of the project sign shall be red with white lettering (matching local sponsor's colors). Paint colors shall be as follow:

Black - Federal Standard 595a Color Number 27038
White - Federal Standard 595a Color Number 27875
Red - PANTONE 032

An example of the sign including mounting and fabrication details are also provided at the end of this section.

Name of the project shall be as follows:

USARC/OMS/UNHEATED STORAGE
FORT STORY, VA

Name of the designer shall be as follows:

The Mason & Hanger Group Inc.
300 West Vine Street Suite 1300
Lexington, KY 40507

Name of local sponsor shall be as follows:

99th RSC

Erection and Maintenance.

a. The signs shall be erected at the designated location(s). Signs shall be plumb and backfill of post holes shall be well tamped to properly support the signs in position throughout the life of the contract. The signs shall be maintained in good condition until completion of the contract, shall remain the property of the Contractor, and shall be removed from the site upon completion of work under the contract.

b. The Corps of Engineers logo and the local sponsor's logo will be provided by the Contracting Officer.

Payment. No separate payment will be made for furnishing and erecting the project signs as specified and costs thereof shall be considered a subsidiary obligation of the Contractor.

1.27 NOT USED

1.28 WAGE RATES
1 February 1995

The decision of the Secretary of Labor, covering rates of wages, including fringe benefits to be paid laborers and mechanics performing work under this contract, is attached hereto. The payment for all classes of laborers and mechanics actually employed to perform work under the contract will be specified in the following contract clauses: DAVIS-BACON ACT, CONTRACT WORK HOURS AND SAFETY STANDARDS ACT, and THE COPELAND ACT.

Wage decisions included are: VA020015

1.29 NOT USED

1.30 INTERFERENCE WITH TRAFFIC AND PUBLIC AND PRIVATE PROPERTY.
15 June 1990

a. The Contractor at all times shall dispose his plant and conduct the work in such manner as to cause as little interference as possible with private and public travel. Damage (other than that resulting from normal wear and tear) to roads, shall be repaired to as good a condition as they were prior to the beginning of work and to the satisfaction of the Contracting Officer.

b. The Contractor shall provide and maintain as may be required by the State of VA, Department of Transportation, proper barricades, fences, danger signals and lights, provide a sufficient number of watchmen, and take such other precautions as may be necessary to protect life, property and structures, and shall be liable for and hold the Government free and harmless from all damages occasioned in any way by his act or neglect, or that of his agents, employees, or workmen.

1.31 SEQUENCE OF WORK.
15 September 1995

TBD

1.32 GOVERNMENT FIELD OFFICE FACILITIES AND SERVICES.
1 August 1996

General. The Government field office facilities will be located as indicated and specified in the technical portions of these specifications. Electrical, fuel, water and sewage disposal facilities shall be provided as specified in the technical portions of these specifications and shall be maintained by the Contractor for the duration of the contract. All electricity and fuel oil required for operation of the field office facilities shall be furnished by the Contractor for the duration of the

contract. No separate payment will be made for maintaining the facilities and furnishing these utilities and all costs in connection therewith shall be included in other items authorized for payment. The buildings and facilities will be left in place upon completion of the contract.

Utility Services. The Contractor shall arrange for and pay all costs for water, electricity, liquefied petroleum or fuel oil, and other utilities as necessary for the field office starting on or about 30 days after award and continuing for the life of the contract. The existing equipment shall be cleaned and then serviced a minimum of biweekly.

Payment. No separate payment will be made for these Contractor-furnished services, and all costs thereof shall be incidental to the various bid items of the contract.

1.33 COMPLIANCE WITH POST/BASE REGULATIONS.
1 August 1996

a. The site of the work is on a military reservation and all rules and regulations issued by the Commanding Officer covering general safety, security, sanitary requirements, pollution control and traffic regulations, shall be observed by the Contractor. Information regarding these requirements may be obtained by contacting the Contracting Officer, who will provide such information or assist in obtaining same from appropriate authorities.

b. Contractor personnel shall park only in areas authorized by the Contracting Officer.

c. The Contractor shall provide a Seven Day Notice of Soil Treatment to the Contracting Officer, in writing, before required soil treatment agents are applied, to assure that DOD Certified Pest Control Personnel are present during soil treatment applications. All soil treatment applications must be in the presence of DOD Certified Pest Control personnel.

1.34 EQUIPMENT AND OWNERSHIP AND OPERATING EXPENSE SCHEDULE (MAR 1995)
EFAR 52.231-5000.
20 March 1997

a. This does not apply to terminations. See 52.249-5000, Basis for Settlement of Proposals and FAR Part 49.

b. Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractor at any tier shall be based on actual cost data for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region II. Working conditions shall be considered to be average for

determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retroactive pricing, the schedule in effect at the time of negotiations shall apply.

c. Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

d. When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the Contracting Officer shall request the Contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Cover Sheet.

e. Whenever a modification or equitable adjustment of contract price is required, the contractor's cost proposals for equipment ownership and operating expenses shall be determined in accordance with the requirements of SPECIAL CONTRACT REQUIREMENT: EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE. A copy of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule" is available for review at the office of the District Engineer, Room 821, 600 Dr. Martin Luther King, Jr. Place, Louisville, Kentucky, or a copy may be ordered from the Government Printing Office at a cost of $11.00 by calling telephone no. (301) 953-7974.

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9	008-022-00262-6
10	008-022-00263-4
11	008-022-00264-2
12	008-022-00265-1

1.35 LABOR, EQUIPMENT, AND MATERIAL REPORTS

15 June 1990

Daily Equipment Report. The Contractor shall submit a daily report of all Contractor-owned or rented equipment at the jobsite. A similar report is required for all subcontractor equipment. The subcontractor's report may be separate or included with the Contractor's report provided the equipment is adequately identified as to ownership. The required equipment report shall include each item of equipment (hand-operated small tools or equipment excluded) on the job and shall specifically identify each item as to whether it is Contractor-owned or rented, shifts, hours of usage, down time for repairs, and standby time. Identification of the equipment shall include make, model and plant number of all items. Separate identification by a key sheet providing these data may be utilized with the daily report indicating the type of equipment and the equipment plant numbers. The format of the Daily Equipment Report will be as approved by the Government in the field.

Labor, Equipment & Material Reports for Extra Work/Cost. A Report shall also be submitted by the Contractor listing any labor, equipment and materials expended on and/or impacted by any change order directed by the Government and for which total price/time agreement has not been reached. These requirements also apply to subcontractors at any tier. The same Report is required at any time the Contractor claims or intends to claim for extra costs whether or not there is Government recognition (constructive changes). This requirement is in addition to any Contractor "Notice" or "Reservation of Rights". Submittal of such a report will not be construed as satisfying the "Notice" required under the "Changes" clause or any other clause. But, absence of such Reports submitted to the Government contemporaneously with the alleged extra work/cost will be considered as evidence that no such extra work/cost occurred that are chargeable to the Government.

The Report shall be detailed to the degree required by the Government in the field and shall contain the following as a minimum:

a. The cause of the extra labor, equipment or materials costs.

b. For extra labor - Indicate crew, craft, hours, location and cost. Describe nature or type of extra costs, i.e, extra work, overtime, acceleration, interference, reassignment, mobilizations and demobilizations, supervision, overhead, type of inefficiency, etc.

c. For extra equipment - Indicate type and description, hours, location, cost; whether working, idle, standby, under repair, extra work involved, etc.

d. For extra materials - Indicate type and description, where used, whether consumed, installed or multi-use, quantity, cost, extra work involved, etc.

e. Affected activities - Relate to Contract Schedule (Network Analysis); demonstrate whether delay or suspension is involved.

f. Segregate all entries by prime and each subcontractor.

g. Summarize costs daily and by cumulative subtotal or with frequency required by the Government.

This report will not be considered as evidence that any of the alleged extra costs actually occurred. The report will be used to check against over obligation of funds for change orders directed prior to price/time agreement and to track alleged extra costs the Contractor considers otherwise chargeable against the Government. The Government may respond at any interval to either challenge, amend or confirm the report. Absence of a Government response is not to be considered acquiescence or denial. The Government may order work stoppage if deemed necessary to avoid overobligation of funds. The frequency of the report shall be daily or as otherwise approved by the Government representative in writing.

1.36 NOT USED

1.37 NOT USED

1.38 NOT USED

1.39 NOT USED

1.40 NOT USED

1.41 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (SEP 1989) FAR 52.228-5. 17 July 1992

The Contractor shall, at its own expense, provide and maintain during the entire performance of this contract at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(1) Coverage complying with State laws governing insurance requirements, such as those requirements pertaining to Workman's Compensation and Occupational Disease Insurance. Employer's Liability Insurance shall be furnished in limits of not less than $100,000.00 except in states with exclusive or monopolistic funds.

(2) Comprehensive General Liability Insurance for bodily injury coverage shall be furnished in limits of not less than $500,000 per occurrence.

(3) Comprehensive Automobile Liability Insurance for both bodily injury and property damage, shall be furnished in limits of not less than $200,000.00 per person, $500,000.00 per accident for bodily injury, and $20,000.00 per accident for property damage. When the Financial Responsibility or Compulsory Insurance Law of the State, requires higher limits, the policy shall provide for coverage of at least those higher limits.

Before commencing work under this contract, the Contractor shall submit to the Contracting Officer in writing that the required insurance certification has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation

or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe, or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

The Contractor shall insert the substance of this clause, including this paragraph, in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

1.42 IMPLEMENTATION OF GOVERNMENT RESIDENT MANAGEMENT SYSTEM
March 2002

RMS shall be maintained in accordance with Section 01312A QUALITY CONTROL SYSTEM (QCS).

1.43 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER. ER 415-1-15
(31 OCT 89)
2 January 1991

This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: Fixed Price Construction". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
9	9	9	6	7	6	8	7	6	5	6	9

Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC

report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled work day. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated listed above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)".

1.44 NOT USED

1.45 AVAILABILITY OF SAFETY AND HEALTH REQUIREMENTS MANUAL (EM 385-1-1).
17 May 2000

As covered by CONTRACT CLAUSE "ACCIDENT PREVENTION", compliance with EM 385-1-1 is a requirement for this contract. Copies may be purchased for $31.00 each at the following address:

United States Government Bookstore
Room 118, Federal Building
1000 Liberty Avenue
Pittsburgh, PA 15222-4003
Telephone: (412) 395-5021 FAX: (412) 395-4547

Or downloaded from the following website:

http://www.usace.army.mil/inet/usace-docs/eng-manuals/em385-1-1/toc.htm

1.46 FIRE PROTECTION DURING CONSTRUCTION (MIL-HDBK-1008c Para. 1.6)
15 April 1991

The Contractor is alerted to the requirements of Contract Clause "CLEANING UP" and more specifically to the requirements for fire protection during construction spelled out in EM 385-1-1 and NFPA No. 241 Building Construction and Demolition Operations. This item must be covered in the submittal required under Contract Clause "ACCIDENT PREVENTION".

1.47 NOT USED

1.48 NOT USED

1.49 NOT USED

1.50 CONSTRUCTION HAZARD COMMUNICATION
1 November 1991

The Contractor is required to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1926.59). This standard is designed to inform workers of safe and appropriate methods of working with hazardous substances in the workplace. The standard has five requirements, and every

hazardous or potentially hazardous substance used or stored in the work area is subject to all five. They are:

(1) Hazard Evaluation. Any company which produces or imports a chemical or compound must conduct a hazard evaluation of the substance to determine its potential health or physical hazard. The hazard evaluation consists of an investigation of all the available scientific evidence about the substance. The Contractor is required to assure that all producers (manufacturer/distributors) have performed these evaluations and transmit the required information with any hazardous materials being used or stored on the project site. From the hazard evaluation, a substance may be classified as a health hazard, or a physical hazard. These classifications are then further broken down according to type:

Health Hazards	Physical Hazards
Carcinogens	Combustible liquids
Irritants	Compressed gases
Sensitizers	Explosives
Corrosives	Flammables
Toxic substances	Organic peroxides
Highly toxic substances	Unstable substances
Substances harmful to specific organs or parts of the body	Water-reactive substances

(2) Warning Labels. If a chemical is hazardous or potentially hazardous, the producer or importer must affix a warning label to every container of that chemical before it leaves his facility. The Contractor must assure these labels are attached and legible. The label must identify the chemical, state the hazard, and give the name and address of the producer or importer. If the hazardous substance is transferred to another container, that container must then be labeled, tagged, or marked with the name of the chemical and the appropriate hazard warning. Warning labels should be replaced immediately if they are defaced or removed.

(3) Material Safety Data Sheets. The producer or importer must also supply a material safety data sheet (MSDS). The Contractor must keep these available in the work area where the substance is used, so that the people using the substance can easily review important safety and health information, such as:

The hazard possible from misuse of the substance
Precautions necessary for use, handling, and storage
Emergency procedures for leaks, spills, fire and first aid
Useful facts about the substance's physical or chemical properties

(4) Work Area Specific Training. Because of hazardous substance may react differently depending on how it is used or the environment of the work area, the Contractor must conduct work area specific training; special training which takes the Contractor's operations, environment, and work policies into consideration. Work area training presents:

The hazardous substances which are present in the work place and the hazards they pose

Ways to protect against those hazards, such as protective equipment, emergency procedures, and safe handling

Where the MSDS's are kept, and an explanation of the labeling system
Where the Contractor's written Hazard Communication Program is located

(5) The Written Hazard Communication Program. In accordance with OSHA requirements, the Contractor must prepare a written Hazard Communication Program. This document will be included in the Contractor's Accident Prevention Plan. This document states how the Contractor plans to ensure that hazardous materials are appropriately labeled, how and where MSDS's will be maintained, and how employees will be provided with specific information and training.

1.51 NOT USED

1.52 MECHANICAL AND ELECTRICAL ROOM LAYOUT (ORL).
24 FEBRUARY 1992

Detailed mechanical and electrical room layout drawings shall be submitted for approval in accordance with SD-04 Section 01330. Layout drawings shall show location and maintenance clearances for all mechanical room equipment, and all utility runs/chases for mechanical, electrical, telephone and other similar systems. Drawings shall be submitted at the same time as the submittals for the equipment to be located within the mechanical room.

1.53 RIGHTS IN TECHNICAL DATA--NONCOMMERCIAL ITEMS (NOV 1995)
252.227-7013 (JUN 1995).
20 March 1997

(a) Definitions. As used in this clause:

(1) "Computer data base" means a collection of data recorded in a form capable of being processed by a computer. The term does not include computer software.

(2) "Computer program" means a set of instructions, rules, or routines recorded in a form that is capable of causing a computer to perform a specific operation or series of operations.

(3) "Computer software" means computer programs, source code, source code listings, object code listings, design details, algorithms, processes, flow charts, formulae and related material that would enable the software to be reproduced, recreated, or recompiled. Computer software does not include computer data bases or computer software documentation.

(4) "Computer software documentation" means owner's manuals, user's manuals, installation instructions, operating instructions, and other similar items, regardless of storage medium, that explain the capabilities of the computer software or provide instructions for using the software.

(5) "Detailed manufacturing or process data" means technical data that describe the steps, sequences, and conditions of manufacturing, processing or assembly used by the manufacturer to produce an item or component or to perform a process.

(6) "Developed" means that an item, component, or process exists and is workable. Thus, the item or component must have been constructed or the process practiced. Workability is generally established when the item, component, or process has been analyzed or tested sufficiently to demonstrate to reasonable people skilled in the applicable art that there is a high probability that it will operate as intended. Whether, how much, and what type of analysis or testing is required to establish workability depends on the nature of the item, component, or process, and the state of the art. To be considered "developed," the item, component, or process need not be at the stage where it could be offered for sale or sold on the commercial market, nor must the item, component, or process be actually reduced to practice within the meaning of Title 35 of the United States Code.

(7) "Developed exclusively at private expense" means development was accomplished entirely with costs charged to indirect cost pools, costs not allocated to a government contract, or any combination thereof.

(i) Private expense determinations should be made at the lowest practicable level.

(ii) Under fixed-priced contracts, when total costs are greater than the firm-fixed-price or ceiling price of the contract, the additional development costs necessary to complete development shall not be considered when determining whether development was at government, private, or mixed expense.

(8) "Developed exclusively with government funds" means development was not accomplished exclusively or partially at private expense.

(9) "Developed with mixed funding" means development was accomplished partially with costs charged to indirect cost pools and/or costs not allocated to a government contract, and partially with costs charged directly to a government contract.

(10) "Form, fit, and function data" means technical data that describes the required overall physical, functional, and performance characteristics (along with the qualification requirements, if applicable) of an item, component, or process to the extent necessary to permit identification of physically and functionally interchangeable items.

(11) "Government purpose" means any activity in which the United States Government is a party, including cooperative agreements with international or multi-national defense organizations, or sales or transfers by the United States Government to foreign governments or international organizations. Government purposes include competitive procurement, but do not include the rights to use, modify, reproduce,

release, perform, display, or disclose technical data for commercial purposes or authorize others to do so.

(12) "Government purpose rights" means the right to--

(i) Use, modify, reproduce, release, perform, display, or disclose technical data within the Government without restrictions; and

(ii) Release or disclose technical data outside the Government and authorize persons to whom release or disclosure has been made to use, modify, reproduce, release, perform, display, or disclose that data for United States government purposes.

(13) "Limited rights" means the rights to use, modify, reproduce, release, perform, display, or disclose technical data, in whole or in part, within the Government. The Government may not, without the written permission of the party asserting limited rights, release or disclose the technical data outside the Government, use the technical data for manufacture, or authorize the technical data to be used by another part, except that the Government may reproduce, release or disclose such data or authorize the use or reproduction of the data by persons outside the Government if reproduction, release, disclosure, or use is--

(i) Necessary for emergency repair and overhaul; or

(ii) A release or disclosure of technical data (other than detailed manufacturing or process data) to, or use of such data by, a foreign government that is in the interest of the Government and is required for evaluational or informational purposes;

(iii) Subject to a prohibition on the further reproduction, release, disclosure, or use of the technical data; and

(iv) The contractor or subcontractor asserting the restriction is notified of such reproduction, release, disclosure, or use.

(14) "Technical data" means recorded information, regardless of the form or method of the recording, of a scientific or technical nature (including computer software documentation). The term does not include computer software or data incidental to contract administration, such a financial and/or management information.

(15) "Unlimited rights" means rights to use, modify, reproduce, perform, display, release, or disclose technical data in whole or in part, in any manner, and for any purpose whatsoever, and to have or authorize others to do so.

(b) Rights in technical data.

The Contractor grants or shall obtain for the Government the following royalty free, world-wide, nonexclusive, irrevocable license rights in technical data other than computer software documentation (see Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation clause of this contract for rights in computer software

documentations):

(1) Unlimited rights.

The Government shall have unlimited rights in technical data that are--

(i) Data pertaining to an item, component, or process which has been or will be developed exclusively with Government funds;

(ii) Studies, analyses, test data, or similar data produced for this contract, when the study, analysis, test, or similar work was specified as an element of performance;

(iii) Created exclusively with Government funds in the performance of a contract that does not require the development, manufacture, construction, or production of items, components, or processes;

(iv) Form, fit, and function data;

(v) Necessary for installation, operation, maintenance, or training purposes (other than detailed manufacturing or process data);

(vi) Corrections or changes to technical data furnished to the Contractor by the Government;

(vii) Otherwise publicly available or have been released or disclosed by the Contractor or subcontractor without restrictions on further use, release or disclosure, other than a release or disclosure resulting from the sale, transfer, or other assignment of interest in the technical data to another party or the sale or transfer of some or all of a business entity or its assets to another party;

(viii) Data in which the Government has obtained unlimited rights under another Government contract or as a result of negotiations; or

(ix) Data furnished to the Government, under this or any other Government contract or subcontract thereunder, with--

(A) Government purpose license rights or limited rights and the restrictive condition(s) has/have expired; or

(B) Government purpose rights and the Contractor's exclusive right to use such data for commercial purposes has expired.

(2) Government purpose rights.

(i) The Government shall have government purpose rights for a five-year period, or such other period as may be negotiated, in technical data--

(A) That pertain to items, components, or processes developed with mixed funding except when the Government is entitled to unlimited rights in such data as provided in paragraphs (b)(ii) and (b)(iv)

through (b)(ix) of this clause; or

(B) Created with mixed funding in the performance of a contract that does not require the development, manufacture, construction, or production of items, components, or processes.

(ii) The five-year period, or such other period as may have been negotiated, shall commence upon execution of the contract, subcontract, letter contract (or similar contractual instrument), contract modification, or option exercise that required development of the items, components, or processes or creation of the data described in paragraph (b)(2)(i)(B) of this clause. Upon expiration of the five-year or other negotiated period, the Government shall have unlimited rights in the technical data.

(iii) The Government shall not release or disclose technical data in which it has government purpose rights unless--

(A) Prior to release or disclosure, the intended recipient is subject to the non-disclosure agreement at 227.7103-7 of the Defense Federal Acquisition Regulation Supplement (DFARS); or

(B) The recipient is a Government contractor receiving access to the data for performance of a Government contract that contains the clause at DFARS 252.227-7025, Limitations on the Use or Disclosure of Government-Furnished Information Market with Restrictive Legends.

(iv) The Contractor has the exclusive right, including the right to license others, to use technical data in which the Government has obtained government purpose rights under this contract for any commercial purpose during the time period specified in the government purpose rights legend prescribed in paragraph (f)(2) of this clause.

(3) Limited rights.

(i) Except as provided in paragraphs (b)(1)(ii) and (b)(1)(iv) through (b)(1)(ix) of this clause, the Government shall have limited rights in technical data--

(A) Pertaining to items, components, or processes developed exclusively at private expense and marked with the limited rights legend prescribed in paragraph (f) of this clause; or

(B) Created exclusively at private expense in the performance of a contract that does not require the development, manufacture, construction, or production of items, components, or processes.

(ii) The Government shall require a recipient of limited rights data for emergency repair or overhaul to destroy the data and all copies in its possession promptly following completion f the emergency repair/overhaul and to notify the Contractor that the data have been destroyed.

(iii) The Contractor, its subcontractors, and suppliers are

not required to provide the Government additional rights to use, modify, reproduce, release, perform, display, or disclose technical furnished to the Government with limited rights. However, if the Government desires to obtain additional rights in technical data in which it has limited rights, the Contractor agrees to promptly enter into negotiations with the Contracting Officer to determine whether there are acceptable terms for transferring such rights. All technical data in which the Contractor has granted the Government additional rights shall be listed or described in a license agreement made part of the contract. the license shall enumerate the additional rights granted the Government in such data.

(4) Specifically negotiated license rights.

The standard license rights granted to the Government under paragraphs (b)(1) through (b)(3) of this clause, including the period during which the Government shall have government purpose rights in technical data, may be modified by mutual agreement to provide such rights as the parties consider appropriate but shall not provide the Government lesser rights than are enumerated in paragraph (a)(13) of this clause. Any rights so negotiated shall be identified in a license agreement made part of this contract.

(5) Prior government rights.

Technical data that will be delivered, furnished, or otherwise provided to the Government under this contract, in which the Government has previously obtained rights shall be delivered, furnished, or provided with the pre-existing rights, unless--

(i) The parties have agreed otherwise; or

(ii) Any restrictions on the Government's rights to use, modify, reproduce, release, perform, display, or disclose the data have expired or no longer apply.

(6) Release from liability.

The Contractor agrees to release the Government from liability for any release or disclosure of technical data made in accordance with paragraph (a)(13) or (b)(2)(iii) of this clause, in accordance with the terms of a license negotiated under paragraph (b)(4) of this clause, or by others to whom the recipient has released or disclosed the data and to seek relief solely from the party who has improperly used, modified, reproduced, released, performed, displayed, or disclosed Contractor data marked with restrictive legends.

(c) Contractor rights in technical data.

All rights not granted to the Government are retained by the Contractor.

(d) Third party copyrighted data.

The Contractor shall not, without the written approval of the

Contracting Officer, incorporate any copyrighted data in the technical data to be delivered under this contract unless the Contractor is the copyright owner or has obtained for the Government the license rights necessary to perfect a license or licenses in the deliverable data of the appropriate scope set forth in paragraph (b) of this clause, and has affixed a statement of the license or licenses obtained on behalf of the Government and other persons to the data transmittal document.

(e) Identification and delivery of data to be furnished with restrictions on use, release, or disclosure.

(1) This paragraph does not apply to restrictions based solely on copyright.

(2) Except as provided in paragraph (e)(3) of the clause, technical data that the Contractor assets should be furnished to the Government with restrictions on use, release, or disclosure are identified in an attachment to this contract (see Attachment). The Contractor shall not deliver any data with restrictive markings unless the data are listed on the Attachment.

(3) In addition to the assertions made in the Attachment, other assertions may be identified after award when based on new information or inadvertent omissions unless the inadvertent omissions would have materially affected the source selection decision. Such identification and assertion shall be submitted to the Contracting Officer as soon as practicable prior to the scheduled date for delivery of the data, in the following format, and signed by an official authorized to contractually obligate the Contractor:

Identification and Assertion of Restrictions on the Government's Use, Release, or Disclosure of Technical Data.

The Contractor asserts for itself, or the persons identified below, that the Government's rights to use, release, or disclose the following technical data should be restricted--

Technical Data to be Furnished With Restrictions*	Asserted Basis for Assertion**	Rights Category***	Name of Person Asserting Restrictions****
(LIST)	(LIST)	(LIST)	(LIST)

*If the assertion is applicable to items, components, or processes developed at private expense, identify both the data and each such item, component, or process.

**Generally, the development of an item, component, or process at private expense, either exclusively or partially, is the only basis for asserting restrictions on the Government's rights to use, release, or disclose technical data pertaining to such terms, components, or processes. Indicate whether development was exclusively or partially at private expense. If development was not at private expense, enter the specific reason for asserting that the Government's right should be restricted.

***Enter asserted rights category (e.g. government purpose license rights from a prior contract, rights in SBIR data generated under another contract, limited or government purpose rights under this or a prior contract, or specifically negotiated licenses).

****Corporation, individual, or other person, as appropriate.

Date _____

Printed Name and Title _____

_____

Signature _____

_____

(End of identification and assertion)

(4) When requested by the Contracting Officer, the Contractor shall provide sufficient information to enable the Contracting Officer to evaluate the Contractor's assertions. The Contracting Officer reserves the right to add the Contractor's assertions to the Attachment and validate any listed assertion, at a later date, in accordance with the procedures of the Validation of Restrictive Markings on Technical Data clause of this contract.

(f) Marking requirements.

The Contractor, and its subcontractor or suppliers, may only assert restrictions on the Government's rights to use, modify, reproduce, release, perform, display, or disclose technical data to be delivered under this contract by marking the deliverable data subject to restriction. Except as provided in paragraph (f)(5) of this clause, only the following legends are authorized under this contract: the government purpose rights legend at paragraph (f)(2) of this clause: the limited rights legend at paragraph (f)(3) of this clause: or the special license rights legend at paragraph (f)(4) of this clause, and/or a notice of copyright as prescribed under 17 U.S.C. 401 or 402.

(1) General marking instructions.

The Contractor, or its subcontractors or suppliers, shall conspicuously and legibly mark the appropriate legend on all technical data that qualify for such markings. The authorized legends shall be placed on the transmittal document or storage container and, for printed material, each page of the printed material containing technical data for which restrictions are asserted. When only portions of a page of printed material are subject to the asserted restrictions, such portions shall be identified by circling, underscoring, with a note, or other appropriate identifier. Technical data transmitted directly from one computer or computer terminal to another shall contain a notice of asserted restrictions. Reproductions of technical data or any portions thereof subject to asserted restrictions shall also reproduce the asserted

restrictions.

(2) Government purpose rights markings.

Data delivered or otherwise furnished to the Government with government purpose rights shall be marked as follows:

GOVERNMENT PURPOSE RIGHTS

Contract No. _____

Contractor Name _____

Contractor Address _____

_____

Expiration Date _____

The Government's rights to use, modify, reproduce, release, perform, display, or disclose these technical data are restricted by paragraph (b)(2) of the Rights in Technical Data--Noncommercial Items clause contained in the above identified contract. No restrictions apply after the expiration date shown above. Any reproduction of technical data or portions thereof marked with this legend must also reproduce the markings.

(End of legend)

(3) Limited rights markings.

Data delivered or otherwise furnished to the Government with limited rights shall be marked with the following legend:

LIMITED RIGHTS

Contract No. _____

Contractor Name _____

Contractor Address _____

_____

The Government's rights to use, modify, reproduce, release, perform, display, or disclose these technical data are restricted by paragraph (b)(3) of the Rights in Technical Data--Noncommercial Items clause contained in the above identified contract. Any reproduction of technical data or portions thereof marked with this legend must also reproduce the markings. Any person, other than the Government, who has been provided access to such data must promptly notify the above name Contractor.

(End of legend)

(4) Special license rights markings.

(I) Data in which the Government's rights stem from a specifically negotiated license shall be marked with the following legend:

SPECIAL LICENSE RIGHTS

The Government's rights to use, modify, reproduce, release, perform, display, or disclose these data are restricted by Contract No. _____)Insert contract number) _____, License No. _____ (Insert license identifier) _____. Any reproduction of technical data or portions thereof marked with this legend must also reproduce the markings.

(End of legend)

(ii) For purposes of this clause, special licenses do not include government purpose license rights acquired under a prior contract (see paragraph (b)(5) of this clause)_.

(5) Pre-existing data markings.

If the terms of a prior contract or license permitted the Contractor to restrict the Government's rights to use, modify, reproduce, release perform, display, or disclose technical data deliverable under this contract, and those restrictions are still applicable, the Contractor may mark such data with the appropriate restrictive legend for which the data qualified under the prior contract or license. The marking procedures in paragraph (f)(1) of this clause shall be followed.

(g) Contractor procedures and records.

Throughout performance of this contract, the Contractor and its subcontractors or suppliers that will deliver technical data with other than unlimited rights, shall--

(1) Have, maintain, and follow written procedures sufficient to assure that restrictive markings are used only when authorized by the terms of this clause, and

(2) Maintain records sufficient to justify the validity of any restrictive markings on technical data delivered under this contract.

(h) Removal of unjustified and nonconforming markings.

(1) Unjustified technical data markings.

The rights and obligations of the parties regarding the validation of restrictive markings or technical data furnished or to be furnished under this contract are contained in the Validation of Restrictive Markings on Technical Data clause of this contract. Notwithstanding any provision of this contract concerning inspection and acceptance, the Government may ignore or, at the Contractor's expense, correct or strike a marking if, in

accordance with the procedures in the Validation of Restrictive Markings on Technical Data clause of this contract, a restrictive marking is determined to be unjustified.

(2) Nonconforming technical data markings.

A nonconforming marking is a marking placed on technical data delivered or otherwise furnished to the Government under this contract that is not in the format authorized by this contract. Correction of nonconforming markings is not subject to the Validation of Restrictive Markings on Technical Data clause of this contract. If the Contracting Officer notifies the Contractor of a nonconforming marking and the Contractor fails to remove or correct such marking within sixty (60) days, the Government may ignore or, at the Contractor's expense, remove or correct any nonconforming marking.

(I) Relation to patents.

Nothing contained in this clause shall imply a license to the Government under any patent or be construed as affecting the scope of any license or other with otherwise granted to the Government under any patent.

(j) Limitation on charges for rights in technical data.

(1) The Contractor shall not charge to this contract any cost, including, but not limited to, license fees, royalties, or similar charges, for rights in technical data to be delivered under this contract when--

(I) The Government has acquired, by any means, the same or greater rights in the data; or

(ii) The data are available to the public without restrictions.

(2) The limitation in paragraph (j)(1) of this clause--

(I) Includes costs charged by a subcontractor or supplier, at any tier, or costs incurred by the Contractor to acquire rights in subcontractor or supplier technical data, if the subcontractor or supplier has been paid for such rights under any other Government contract or under a license conveying the rights to the Government; and

(ii) Does not include the reasonable costs of reproducing, handling, or mailing the documents or other media in which the technical data will be delivered.

(k) Applicability to subcontractors or suppliers.

(1) The Contractor shall ensure that the rights afforded its subcontractors and suppliers under 10 U.S.C. 2320, 10 U.S.C. 2321, and the identification, assertion, and delivery processes of paragraph (e) of this clause are recognized and protected.

(2) Whenever any technical data for noncommercial items is to be obtained from a subcontractor or supplier for delivery to the Government

under this contract, the Contractor shall use this same clause in the subcontract or other contractual instrument, and require its subcontractors or suppliers to do so, without alteration, except to identify the parties. No other clause shall be used to enlarge or diminish the Government's, the Contractor's, or a higher-tier subcontractor's or supplier's rights in a subcontractor's or supplier's technical data.

(3) Technical data required to be delivered by a subcontractor or supplier shall normally be delivered to the next higher-tier contractor, subcontractor, or supplier. However, when there is a requirement in the prime contract for data which may be submitted with other than unlimited rights by a subcontractor or supplier, then said subcontractor or supplier may fulfill its requirement by submitting such data directly to the Government, rather than through a higher-tier contractor, subcontractor, or supplier.

(4) The Contractor and higher-tier subcontractors or suppliers shall not use their power to award contracts as economic leverage to obtain rights in technical data from their subcontractors or suppliers.

(5) In no event shall the Contractor use its obligation to recognize and protect subcontractor or supplier rights in technical data as an excuse for failing to satisfy its contractual obligation to the Government.

1.54 LIMITATIONS ON THE USE OR DISCLOSURE OF GOVERNMENT-FURNISHED INFORMATION MARKED WITH RESTRICTIVE LEGEND DFARS 252.227-7025 (JUN 1995) 2 January 1996

(a)(1) For contracts requiring the delivery of technical data, the terms, "limited rights" and "Government purpose rights" are defined in the Rights in Technical Data--Noncommercial Items clause of this contract.

(2) For contracts that do not require the delivery of technical data, the terms "government purpose rights" and "restricted rights" are defined in the Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation clause of this contract.

(3) For Small Business Innovative Research program contracts, the terms "limited rights" and "restricted rights" are defined in the Rights in Noncommercial Technical Data and Computer Software--Small Business Innovative Research (SBIR) Program clause of this contract.

(b) Technical data or computer software provided to the Contractor as Government furnished information (GFI) under this contract may be subject to restrictions on use, modification, reproduction, release, performance, display, or further disclosure.

(1) GFI marked with limited or restricted rights legends.

The Contractor shall use, modify, reproduce, perform, or display technical data received from the Government with limited rights legends or computer software received with restricted rights legends only in the performance of this contract. The Contractor shall not, without the

express written permission of the party whose name appears in the legend, release or disclose such data or software to any person.

(2) GFI marked with government purpose rights legends.

The Contractor shall use technical data or computer software received from the Government with government purpose rights legends for government purposes only. The Contractor shall not, without the express written permission of the party whose name appears in the restrictive legend, use, modify, reproduce, release, perform, or display such data or software for any commercial purpose or disclose such data or software to a person other than its subcontractors, suppliers, or prospective subcontractors or suppliers, who require the data or software to submit offers for, or perform, contracts under this contract. Prior to disclosing the data or software, the Contractor shall require the persons to whom disclosure will be made to complete and sign the non-disclosure agreement at 227.7103-7 of the Defense Federal Acquisition Regulation Supplement (DFARS).

(3) GFI marked with specially negotiated license rights legends.

The Contractor shall use, modify, reproduce, release, perform, or display technical data or computer software received from the Government with specially negotiated license legends only as permitted in the license. Such data or software may not be release or disclosed to other persons unless permitted by the license and, prior to release or disclosure, the intended recipient has completed the non-disclosure agreement at DFARS 227.7103-7. The Contractor shall modify paragraph (1)(c) of the non-disclosure agreement to reflect the recipient's obligations regarding use, modification, reproduction, release, performance, display, and disclosure of the data of software.

(c) Indemnification and creation of third party beneficiary rights.

The Contractor agrees--

(1) To indemnify and hold harmless the Government, its agents, and employees from every claim or liability, including attorneys fees, court costs, and expenses, arising out of, or in any way related to, the misuse or unauthorized modification, reproduction, release, performance, display, or disclosure of technical data or computer software received from the Government with restrictive legends by the Contractor or any person to whom the Contractor has released or disclosed such data or software; and

(2) That the party whose name appears on the restrictive legend, in addition to any other rights it may have, is a third party beneficiary who has the right of direct action against the Contractor, or any person to whom the Contractor has released or disclosed such data or software, for the unauthorized duplication, release, or disclosure of technical data or computer software subject to restrictive legends.

1.55 NOT USED

1.56 NOT USED

1.57 PARTNERING
August 1996

In order to most effectively accomplish this contract, the Government proposes to form a partnership with the Contractor to develop a cohesive building team. It is anticipated that this partnership would involve the Corps of Engineers, the Directorate of Environmental and Master Planning, the Contractor, primary subcontractors and the designers. This partnership would strive to develop a cooperative management team drawing on the strengths of each team member in an effort to achieve a quality project within budget and on schedule. This partnership would be bilateral in membership and participation will be totally voluntary. All costs, excluding labor and travel expenses, shall be shared equally between the Government and the Contractor. The Contractor and Government shall be responsible for their own labor and travel costs.

1.58 NOT USED

1.59 CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT PLAN
16 July 1999

a. The Contractor is required to submit for government approval a detailed C&D Waste Management Plan within 30 days after contract award and prior to initiating any site clearance or C&D work.

b. Specific elements to be addressed in the plan are as follows: Designated individuals on the contractor's staff who are responsible for C&D waste prevention and management.

(1) Actions that will be taken to reduce solid waste generation (including use of more efficient facility design and construction processes, reduced packaging and packing materials, supplier take-back programs, etc.). Description of the specific approaches to be used in recycling/reuse of the various materials generated, including, as appropriate, the specification of areas and equipment to be used for processing, sorting, and temporary storage of C&D wastes.

(2) Characterization of the waste to be generated during the C&D project, to include types and quantities of waste materials. The characterization should address site waste materials, building materials, packaging, packing, wastes generated by construction equipment, wastes generated by site offices, and wastes generated by the workforce on-site.

(3) Landfill and/or incinerator name, tipping fee amounts, projected cost of disposing of all trash and waste materials in the landfill/incinerator, as if there would be no salvage or recycling on the project.

(4) Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and public arts programs that accept used materials (e.g., Habitat For Humanity, national materials exchange networks).

(5) A list of specific waste materials that will be salvaged for

resale, salvaged and reused, and recycled; the recycling facilities that will be utilized; and copies of their permits and/or registrations.

(6) Identification of materials that cannot be recycled/reused with a written justification. All disposed materials including anticipated hazardous wastes must include names of haulers and disposal sites, and copies of their permits and/or registrations.

(7) Anticipated net cost savings determined by subtracting contractor program management costs and the cost of salvage (deconstruction), separating, and recycling from the following:

(1)revenue from the sale of salvaged products and materials;
(2)revenue from the sale of recycled products and materials;
(3)revenue from the return of materials; and
(4)incineration and/or landfill tipping fees saved due to diversion of materials.

(8) The plan must cover the following materials if the material is applicable to the specific project.

Asphalt	Gypsum
Concrete	Plastic
Soil	Polystyrene
Metal	Porcelain
Wood	Corrugated cardboard
Brick	Carpet

c. Firms and facilities used by the contractor for recycling, reuse, and disposal shall be appropriately permitted for the contractor's intended use, to the extent required by federal, state, and local regulations. The contractor shall maintain records of disposition of the materials, including all copies of manifests, origin, and disposal forms, and bills of lading. All facility, landfill, and hauler permits showing USEPA and state registration numbers shall be maintained and shall be available to the contracting officer when requested.

d. The Contracting Officer shall review the C&D waste management plan in coordination with the environmental office within 7 calendar days of submittal. Where the contracting officer determines that the contractor has diligently explored all feasible methods to reduce C&D waste, the plan shall be approved, or approved with comment. Where it is determined that the contractor has not diligently explored all feasible methods, the contracting officer shall request a resubmittal.

e. All revenues generated by reusing, returning, salvaging, or recycling materials, as well as costs avoided by reduced tipping and incineration fees as compared to conventional disposal shall accrue to the contractor's benefit and be reported to the Contracting Officer. Where an on-site Army C&D landfill is the only available disposal facility, the Contractor will be changed the prevailing commercial rate.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

-- End of Section --

STATEMENT AND ACKNOWLEDGMENT

FORM APPROVED OMB NO
9000-0014

Public reporting burden for this collection of information is estimated to average .15 hours per response, including the time for reviewing instructions. Searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the suggestions for reducing this burden, to the FAR Secretarial (VRS), Office of Federal Acquisition and Regulatory Policy, GSA Washington, D.C. 20405: and to the Office of Management and Budget, Paperwork Reduction Project (9000-0014), Washington, D.C. 20503

PART I - STATEMENT OF PRIME CONTRACTOR

1. PRIME CONTRACT NO.	2. DATE SUBCONTRACT AWARDED	3. SUBCONTRACT NUMBER

4. PRIME CONTRACTOR (Name, address and ZIP code)	5. SUBCONTRACTOR (Name, address and ZIP code)

6. The prime contractor states that under the contract shown in item 1, a subcontract was awarded on date shown in item 2 by (Name of Awarding Firm)

to the subcontractor identified in item 5, for the following work:

7. PROJECT	8. LOCATION	
9. NAME AND TITLE OF PERSON SIGNING	10. BY (Signature)	11. DATE SIGNED

PART II - ACKNOWLEDGMENT OF SUBCONTRACTOR

12. The subcontractor acknowledges that the following clauses of the contract shown in item 1 are included in this subcontract:

Contract Work Hours and Safety Standards Act - Overtime Compensation - Construction	David-Bacon Act
Payrolls and Basic Records	Apprentices and Trainees
Withholding of Funds	Compliance with Copeland Regulations
Disputes Concerning Labor Standards	Subcontracts
	Contract Termination-Debarment
	Certification of Eligibility

13. NAME(S) OF ANY INTERMEDIATE SUBCONTRACTORS, IF ANY

14. NAME AND TITTLE OF PERSON SIGNING	15. BY (Signature)	16 DATE SIGNED

24 October 1988

(Sample of Typical contractor Quality report)

CONTRACTOR'S NAME
(Address)

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Contract No:_____ Date:_____ Report No._____
Project Name_____
Weather: (Clear) (P. Cloudy) (Cloudy); Temperature: ____Min.____Max; ____Rainfall ____in.

Contractor/Subcontractors/Supplier	Area of Responsibility
a.	
b.	
c.	
d.	
e.	
f.	
g.	

1. Definable Features of Construction in Progress: (Give briefly only definable features of work in progress and location. Refer to work performed by prime and/or subcontractor and/or supplier by letter in table above).

2. Material and/or Equipment Delivered to site:

3. Results of Surveillance:

Preparatory Phase (Attach minutes):

Initial Phase (Attach minutes):

Follow-up Phase (Include satisfactory work completed and/or deficiencies with action to be taken):

4. Tests Required by Plans and/or Specification Performed and results of Test:
(Attach results of test taken on previous dates).

5. Verbal Instructions Received: (List any instructions given by Government Personnel on construction deficiencies. Retesting required, etc., with action to be taken.

6. Safety Deficiencies Noted. (Describe corrective actions taken).

7. Remarks: (Cover any conflicts in plans, specifications, or instruction).

CONTRACTOR'S VERIFICATION: The above report is complete and correct and all material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

Contractor's Authorized QC Representative

All Construction Project Identification signs and Safety Performance signs are to be fabricated and installed as described below. The signs are to be erected at a location designated by the contracting officer and shall conform to the size, format, and typographic standards shown

The sign panels are to be fabricated from .75" High Density Overlay Plywood.

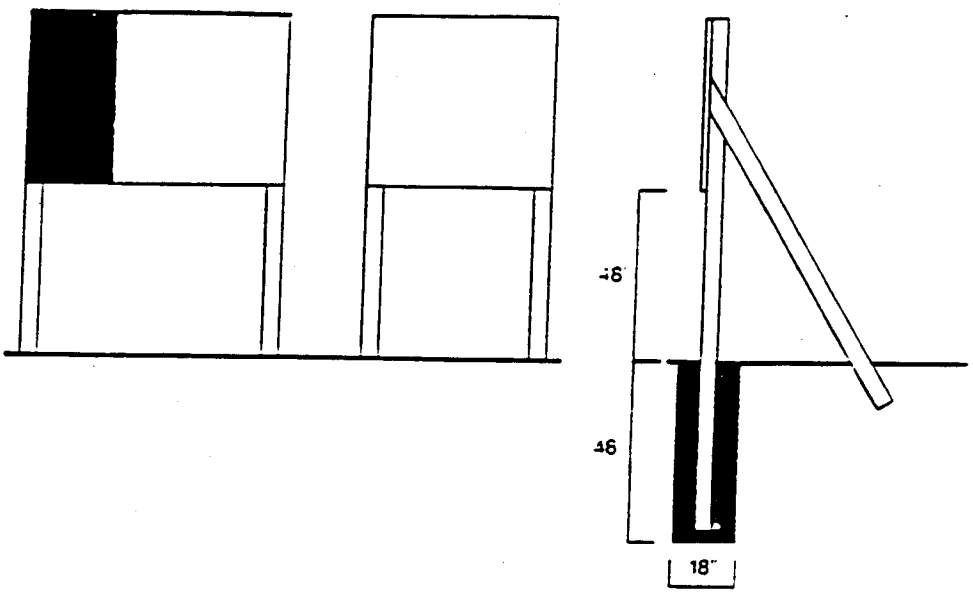
All graphics are to be applied to the background panel following the graphic formats as indicated.

Drill and insert six (6) .375" T-nuts from the front face of the HDO sign panel. Flange of T-nut to be flush with sign face.

Apply lettering and logo to prepared HDO plywood panel.

Sign uprights to be structural grade 4"x4" treated Douglas Fir or Southern Yellow Pine, No. 1 or better. Post to be 12' long. Drill six (6) .375" mounting holes in uprights to align with T-nuts in sign panel. Countersink (.5") back of hole to accept socket head cap screw (4"x.375").

Assemble sign panel and uprights. Imbed assembled sign panel and uprights in 4' hole. Bolt additional 2"x4" struts on inside face of uprights to reinforce installation as shown.



Construction Project Sign

Legend Group 1: Corps Relationship

1. _____
2. _____

Legend Group 2: Corps Signature

1. U.S. Army Corps
2. of Engineers

Legend Group 2A: District Name

1. _____
2. _____

Legend Group 3: Project Title

1. _____
2. _____
3. _____

Legend Group 4: Facility Name

1. _____
2. _____

Legend Group 5a: Designer

1. _____
2. _____
3. _____
4. _____
5. _____

Legend Group 5b: Contractor

1. _____
2. _____
3. _____
4. _____
5. _____

Introduction: Project Identification Sign

Below are two samples of the construction project identification sign showing how this panel is adaptable for use to identify either civil works projects with a local sponsor (top) or military (bottom). The graphic format for this 4' x 6' sign panel follows the legend guidelines and layout as specified below. The large 4' x 4' section of the panel on the right is to be white with black legend. For the top sign, the upper left 2' x 2' section of the sign with the full Corps signature is to be painted Communications Red with white lettering. The lower left 2' x 2' section of the sign shall match the local sponsor's colors with white lettering. For the bottom sign, the 2' x 4' left section of the sign with full Corps signature is to be painted Communications Red with white lettering. Mounting and fabrication details are provided.

Legend Group 1: One-to two-line description of Corps relationship to project.
Color: White
Typeface: 1.25" Helvetica Regular
Maximum line length: 19"

Legend Group 2: Two-line Corps Signature (US Army Corps of Engineers). Placed below Corps Castle
Color: White
Typeface: 1.5" Helvetica Bold

Legend Group 2a: District Name. Placed below Signature (6" Castle).
Color: White
Typeface: 1.25" Helvetica Regular

Legend Group 3: Words "Local Sponsor"
Color: White
Typeface: 1.25" Helvetica Regular
Maximum length: 19"

Legend Group 4: One-to-three lines for name of local sponsor
Color: White
Typeface: 1.5" Helvetica Regular

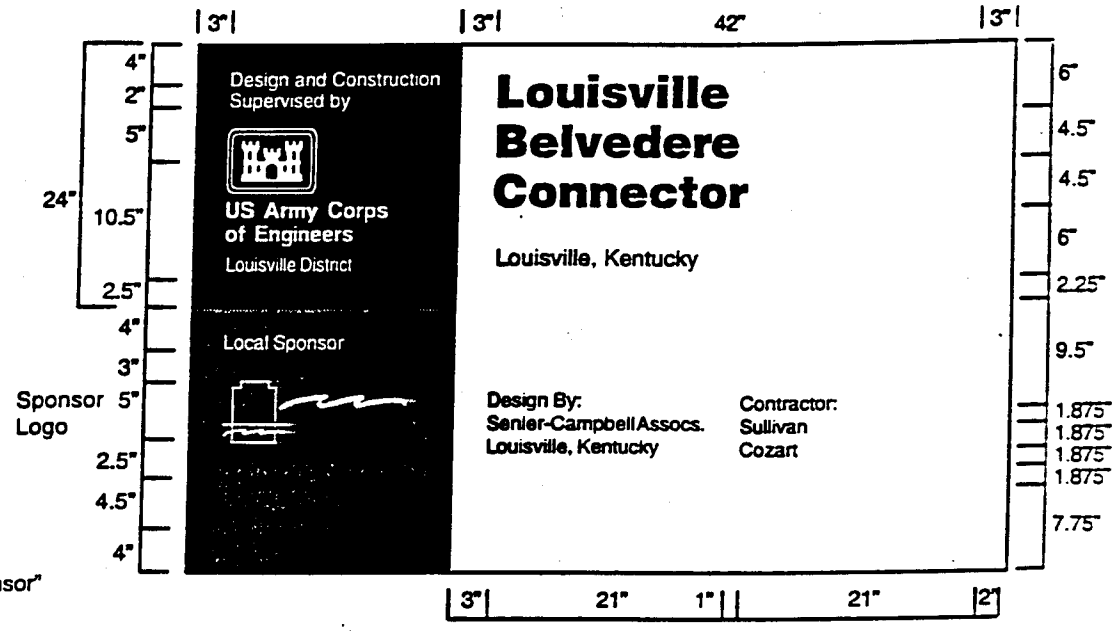
Legend Group 5: One- to three-line project title legend describes the work being done under this contract.
Color: Black
Typeface: 3" Helvetica Bold
Maximum line length: 42"

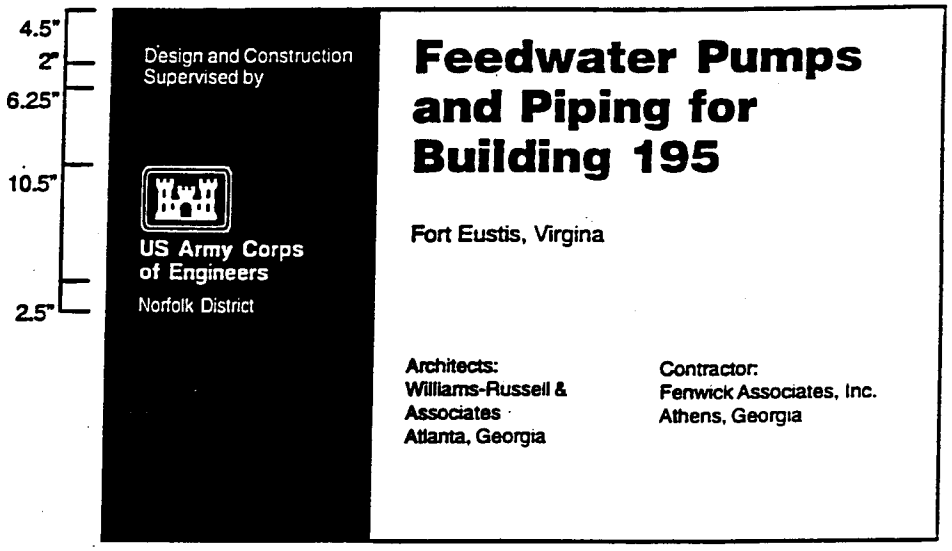
Legend Group 6: One- to two-line identification of project or facility (civil works) or name of sponsoring department (military).
Color: Black
Typeface: 1.5" Helvetica Regular
Maximum line length: 42"

Cross-align the first line of Legend Group 5 with the first line of the Corps Signature (US Army Corps) as shown.

Legend Groups 7a-b: One- to five-line identification of prime contractors including: type (general contractor, etc.) corporate or firm name, city, state.
Color: Black
Typeface: 1.25" Helvetica Regular
Maximum line length: 21"

All typography is flush left and rag right, upper and lower case with initial capitals only as shown.





Legend Size	Panel Size	Post Size	Mounting Height	Color Bkg/Lgd
Various	4' x 6'	4" x 4"	48"	WH-RD/BK

SUBMITTAL REGISTER

(ER 415-1-10)

CONTRACT NO.:

TITLE AND LOCATION

CONTRACTOR:

SPECIFICATION SECTION:

ACTIVITY NO	TRANS-MITTAL NO.	ITEM NO	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL									CLASSI-FICATION		REVIEWER	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS
					DATA	DRAWINGS	INSTRUCTIONS	SCHEDULES	STATEMENTS	REPORTS	CERTIFICATES	SAMPLES	RECORDS	O&M MANUALS	INFORMATION ONLY	GOVERNMENT APPROVED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CODE	DATE	SUBMIT TO GOVERN-MENT	CODE	DATE	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	aa

ENG FORM 4288-R, JAN 97 **EDITION OF MAR 95 IS OBSOLETE.** PAGE ____ OF ____ PAGES (Proponent: CEMP-CE)

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE *(Read instructions on the reverse side prior to initiating this form)*	DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____
SPECIFICATION SEC. NO. *(Cover only one section with each transmittal)*	PROJECT TITLE AND LOCATION		CHECK ONE: THIS TRANSMITTAL IS FOR FIO ☐ GOV'T ☐ APPROVAL

ITEM NO. a.	DESCRIPTION OF ITEM SUBMITTED *(Type size, model number/etc.)* b.	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See Instruction no. 8) c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT SPEC. PARA. NO. e.	DRAWING SHEET NO. f.	FOR CONTRACTOR USE CODE g.	VARIATION (See instruction no. 6) h.	FOR CE USE CODE i.

REMARKS	I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated _____ NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED *(List by Item No.)*	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

Instructions

1. Section I will be initiated by the contractor in the required number of copies.

2. Each transmittal shall be numbered consecutively in the space provided for “Transmittal No.”. This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; in resubmittals, insert transmittal number of last submission as well as the new submittal number.

3. The “Item No.” will be the same “Item No.” as indicated on ENG FORM 4288-R for each entry on this form.

5. Separate transmittal form will be used for submittals under separate section of the specifications.

6. a check shall be placed in the “Variation” column when a submittal is not in accordance with the plans and specifications—also, a written statement to that effect shall be included in the space provided for “Remarks.

7. Form is self-transmittal, letter of transmittal is not required.

8. When a sample of material or Manufacturer’s Certificate of Compliance is transmitted, indicate “Sample” or “Certificate” in column c, Section I.

9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g. to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A – Approved as submitted.

B – Approved, except as noted on drawings.

C – Approved, except as noted on drawings. Refer to attached sheet resubmission required.

D – Will be returned by separate correspondence.

E – Disapproved (See attached).

F – Receipt acknowledged.

FX – Receipt acknowledged, does not comply as noted with contract requirements.

G – Other *(Specify)*

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

(Reverse of ENG form 4025-R)

EQUIPMENT-IN-PLACE LIST

Contract No._____

Description of Item:_____

Model No:_____

Serial No:_____

Capacity:_____

Name of Mfg:_____

Condition:_____

Checked by:_____Replacement Cost_____

Description of Item:_____

Model No:_____

Serial No:_____

Capacity:_____

Name of Mfg:_____

Condition:_____

Checked by:_____Replacement Cost_____

Description of Item:_____

Model No:_____

Serial No:_____

Capacity:_____

Name of Mfg:_____

Condition:_____

Checked by:_____Replacement Cost_____

(If Para. 10 is used, use this form)

DEFICIENCY LIST

CONTRACT NUMBER:_____ PROJECT: _____

		DEFICIENCY		CORRECTION		
DEFIC. NO.	DESCRIPTION	DATE OBSERVED	CQC REPORT NO.	DATE CORRECTED	CQC REPORT NO.	COMMENTS

CONTRACTOR QUALITY CONTROL REPORT

REPORT NO.

DATE

PROJECT/CONTRACT NUMBER

SUPERINTENDENT

CONTRACTOR

WEATHER

PRECIPITATION PAST 24 HOURS (IN INCHES)

TEMPERATURE °F MINIMUM _ MAXIMUM

WERE THERE ANY DELAYS IN WORK PROGRESS TODAY? No ___ Yes___ If Yes, Explain:

VERBAL INSTRUCTIONS GIVEN BY THE GOVERNMENT:

HAS ANYTHING DEVELOPED WHICH MIGHT LEAD TO A CHANGE ORDER OR CLAIM? No___ Yes___ If Yes, Explain:

NOTE: Official notification of claim must be made to the Contracting Officer by seperate correspondence.

SAFETY INSPECTION/MEETINGS: Indicate inspections made, items inspected, deficiencies noted and corrective action taken.

WERE THERE ANY LOST TIME ACCIDENTS THIS DATE? No___ Yes___ If Yes, attach accident report.

PRIME CONTRACTOR/SUBCONTRACTOR WORKFORCE
(If space provided below is inadequate, use additional sheets)

No.	TRADE	HOURS	EMPLOYER	No.	TRADE	HOURS	EMPLOYER

CUMULATIVE TOTAL HOURS OF WORK HOURS FROM PREVIOUS REPORT

TOTAL WORK HOURS ON JOB SITE THIS DATE

TOTAL WORK HOURS FROM START OF CONSTRUCTION

MAJOR ITEMS OF EQUIPMENT

TYPE/CAPACITY	No.	STANDBY HOURS	OPERATING HOURS

9. THREE PHASE INSPECTION

ADVANCE NOTICE OF PREPARATORY, INITIAL OR FINAL FOLLOW-UP INSPECTION: (minimum five working days notice required)

PREPARATORY INSPECTION HELD TODAY: Indicate Definable Features of Work. Attach Preparatory Checklist.

INITIAL INSPECTION HELD TODAY: Indicate Definable Features of Work. Attach Initial Checklist.

FINAL FOLLOW-UP INSPECTION HELD TODAY: Indicate NAS Activity Number. Attach Final Follow-up Checklist.

10. ACTIVITIES IN PROGRESS: Attach daily CQC follow-up inspection deficiencies/corrections noted.

ACTIVITY NUMBER	S=START C=CONTINUING F=FINISH	DESCRIPTION OF WORK ACTUALLY PERFORMED/MAJOR MATERIAL DELIVERIES TODAY

11. CQC TESTING

ACTIVITY NUMBER	DESCRIPTION OF TESTS PERFORMED	PASSED/FAILED

12. USER SCHOOLING CONDUCTED:

ACTIVITY NUMBER	DESCRIPTION OF SCHOOLING

13. INSTALLED PROPERTY PRICING DATA ATTACHED: YES____ NO____

14. TRANSFERRED PROPERTY, DD-1149 ATTACHED: YES____ NO____

15. QA COMMENTS CORRECTED TODAY: YES____ NO____

16. EQUIPMENT SAFETY CHECKLIST ATTACHED: YES____ NO____

GENERAL COMMENTS:

CONTRACTOR CERTIFICATION: On behalf of the contractor, I certify that this report is complete and correct and all equipment and material used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Authorized Contractor Representative: _____

Report Date: _____ Date Submitted to Government Representative: _____

PROJECT NAME : _____ 21 Jul 92
LOCATION : _____
CONTRACT NO. : _____

CONTRACTOR PLANNING INFORMATION

PRIME CONTRACTOR

Prime Contractor : _____
Full Name & Address : _____
_____
_____

County : _____

PRIME CONTRACTOR STAFFING

Project Manager _____ Phone _____

Superintendent _____ Phone _____
Assist. Supt. _____

Quality Control Staff:

QC Name	Category Assignments	Category Codes
_____	, , , , , , , ,	A = ARCHITECTURAL
		E = ELECTRICAL
_____	, , , , , , , ,	P = PLUMBING
		M = MECHANICAL
_____	, , , , , , , ,	F = FIRE SPRINKLER
		S = STRUCTURAL
_____	, , , , , , , ,	R = ROOFING
		C = CIVIL
		T = SAFETY

CONTRACTOR LETTER CODES

LETTER from SITE OFFICE : _____
LETTER from HOME OFFICE : _____

MONTHLY PROGRESS SCHEDULE

Aug 1991 -	Aug 1992 -	Aug 1993 -
Sep 1991 -	Sep 1992 -	Sep 1993 -
Oct 1991 -	Oct 1992 -	Oct 1993 -
Nov 1991 -	Nov 1992 -	Nov 1993 -
Dec 1991 -	Dec 1992 -	Dec 1993 -
Jan 1992 -	Jan 1993 -	Jan 1994 -
Feb 1992 -	Feb 1993 -	Feb 1994 -
Mar 1992 -	Mar 1993 -	Mar 1994 -
Apr 1992 -	Apr 1993 -	Apr 1994 -
May 1992 -	May 1993 -	May 1994 -
Jun 1992 -	Jun 1993 -	Jun 1994 -
Jul 1992 -	Jul 1993 -	Jul 1994 -

SCHOOL	ACTIVITY NUMBER	SPECIFICATION SECTION	SPECIFICATION PARAGRAPH	REMARKS

SUBMITTAL INFORMATION 21 Jul 92

SECTION	ITEM NUMBER	DESCRIPTION	PARAGRAPH	TYPE	ACTIVITY NUMBER	PROCUREMENT PERIOD	REVIEWING OFFICE	REVIEWER	REVIEW PERIOD

SUBCONTRACTOR INFORMATION

21 Jul 92

ABBREVIATED NAME	TRADE	FULL NAME	STREET ADDRESS	CITY,STATE AND ZIPCODE	AUTO INS. EXPIRES	LIABILITY EXPIRES	WORKMENS EXPIRES	LABOR INTERVI

CONTRACTOR PLANNING (6)

GOVERNMENT PLANNING (5)

SUBCONTRACTOR INFORMATION 21 Jul 92

ABBREVIATED NAME	TRADE	FULL NAME	STREET ADDRESS	CITY,STATE AND ZIPCODE	AUTO INS. EXPIRES	LIABILITY EXPIRES	WORKMENS EXPIRES	LABOR INTERVI

CONTRACTOR PLANNING (6) GOVERNMENT PLANNING (5) PAGE 1 OF

DEFINEABLE FEATURES OF WORK

21 Jul 92

FEATURE OF WORK	ESTIMATED START	PREPARATORY TO INITIAL	FEATURE OF WORK	ESTIMATED START	PREPARATORY TO INITIAL

PAY ACTIVITIES AND ACTIVITY INFORMATION

21 Jul 92

ACTIVITY NUMBER	ACTIVITY DESCRIPTION	BID ITEM #	$ AMOUNT OR QUANTITY	UNIT	FEATURE OF WORK	WORK CATEGORY	(SUB)CONTRACTOR	PROJECT AREA	CONTRACT PHASE	WORK TYPE 1	WORK TYPE 2	WORK TYPE 3

CONTRACTOR PLANNING (9 & 11)

GOVERNMENT PLANNING (10)

QUALITY CONTROL TESTING INFORMATION

21 Jul 92

TEST	ACTIVITY NUMBER	SPEC. SECTION	SPEC. PARAGRAPH	PERFORMED BY	TEST	ACTIVITY NUMBER	SPEC. SECTION	SPEC. PARAGRAPH	PERFORMED BY

CONTRACTOR PLANNING (13)

SUBMITTAL REGISTER

CONTRACT NO.
DACA27-03-B-0004

TITLE AND LOCATION
FT. STORY

CONTRACTOR

ACTIVITY NO (a)	TRANSMITTAL NO (b)	SPEC SECT (c)	DESCRIPTION ITEM SUBMITTED (d)	PARAGRAPH # (e)	CLASSIFICATION (f)	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT (g)	APPROVAL NEEDED BY (h)	MATERIAL NEEDED BY (i)	CONTRACTOR ACTION CODE (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR (l)	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	ACTION CODE (o)	DATE OF ACTION (p)	MAILED TO CONTR/ DATE RCD FRM APPR AUTH (q)	REMARKS (r)
		00800	SD-01 Preconstruction Submittals															
			Small Tool Usage Plan		FIO													
			Labor, Equipment and Material Reports	1.35	G RE													
			Quality Control Plan		G RE													
			SD-05 Design Data															
			Equipment-in-Place List	1.10	FIO													
			Maintenance and Parts Data	1.10	FIO													
			SF1413	1.16	FIO													
			Progress Photographs		FIO													
			Dirt and Dust Control Plan		G RE													
			Construction and Demolition (C&D) Waste Management Plan	1.59	G RE													
			SD-07 Certificates															
			Warranties	1.20	FIO													
			Insurance	1.41	FIO													
			DA Form 3337		G RE													
			SD-11 Closeout Submittals															
			As-Built Drawings	1.8.1	G RE													
			Mechanical Room Layout		G RE													
		01320	SD-01 Preconstruction Submittals															
			Initial Project Schedule		G RE													
			Preliminary Project Schedule		FIO													
			Qualifications		FIO													
			SD-05 Design Data															
			Narrative Report		FIO													

SUBMITTAL REGISTER

CONTRACT NO. DACA27-03-B-0004

TITLE AND LOCATION: FT. STORY

CONTRACTOR

ACTIVITY NO (a)	TRANSMITTAL NO (b)	SPEC SECT (c)	DESCRIPTION ITEM SUBMITTED (d)	PARAGRAPH # (e)	CLASSIFICATION (f)	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT (g)	APPROVAL NEEDED BY (h)	MATERIAL NEEDED BY (i)	CONTRACTOR ACTION CODE (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR (l)	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	ACTION CODE (o)	DATE OF ACTION (p)	MAILED TO CONTR/ DATE RCD FRM APPR AUTH (q)	REMARKS (r)
		01320	Schedule Reports		FIO													
			Periodic Schedule Updates		G	RE												
		01355	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.7	G	RE												
		01356	SD-07 Certificates															
			Mill Certificate or Affidavit	2.1.3	FIO													
		01452	SD-07 Certificates															
			Special Inspector	1.3	G	RE												
			Quality Assurance Plan	1.4	G	RE												
		01460	SD-03 Product Data															
			Commissioning Agent		G	AE												
			Commissioning Team		FIO													
			Test Procedures		G	AE												
			Test Schedule		G	AE												
			SD-06 Test Reports															
			Test Reports		G	AE												
		02220	SD-03 Product Data															
			Work Plan		G	RE												
		02230	SD-03 Product Data															
			Materials Other Than Salable Timber	3.4.2	FIO													
		02300	SD-03 Product Data															
			Earthwork		G	RE												
			SD-06 Test Reports															
			Testing	3.13	G	RE												
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO. DACA27-03-B-0004

TITLE AND LOCATION: FT. STORY

CONTRACTOR

ACTIVITY NO (a)	TRANSMITTAL NO (b)	SPEC SECT (c)	DESCRIPTION ITEM SUBMITTED (d)	PARAGRAPH # (e)	CLASSIFICATION (f)	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT (g)	APPROVAL NEEDED BY (h)	MATERIAL NEEDED BY (i)	CONTRACTOR ACTION CODE (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR (l)	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	ACTION CODE (o)	DATE OF ACTION (p)	MAILED TO CONTR/ DATE RCD FRM APPR AUTH (q)	REMARKS (r)
		02300	Testing	3.13	FIO													
		02315	SD-06 Test Reports															
			Testing	3.14	G RE													
		02316	SD-06 Test Reports															
			Field Density Tests	3.4.3	G RE													
			Testing of Backfill Materials	3.4.2	G RE													
		02364	SD-03 Product Data															
			Termiticide Application Plan		G RE													
			Termiticides	2.1	G RE													
			Foundation Exterior	3.2.3	FIO													
			Utilities and Vents	3.2.4	FIO													
			Crawl and Plenum Air Spaces	3.2.5	FIO													
			Application Equipment	3.4.1	FIO													
			SD-04 Samples															
			Termiticides	2.1	FIO													
			SD-06 Test Reports															
			Equipment Calibration and Tank Measurement	3.4.1	FIO													
			Soil Moisture	3.3.1	FIO													
			SD-07 Certificates															
			Qualifications	1.2	FIO													
		02373	SD-03 Product Data															
			Thread	2.1.2	FIO													
			Manufacturing Quality Control		FIO													
			Manual Sampling and Testing															
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO. DACA27-03-B-0004

TITLE AND LOCATION: FT. STORY

CONTRACTOR

ACTIVITY NO (a)	TRANSMITTAL NO (b)	SPEC SECT (c)	DESCRIPTION ITEM SUBMITTED (d)	PARAGRAPH # (e)	CLASSIFICATION (f)	GOVT A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT (g)	APPROVAL NEEDED BY (h)	MATERIAL NEEDED BY (i)	CONTRACTOR ACTION CODE (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR (l)	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	ACTION CODE (o)	DATE OF ACTION (p)	MAILED TO CONTR/ DATE RCD FRM APPR AUTH (q)	REMARKS (r)
		02373	Geotextile	2.1.1	G	RE												
		02510	SD-03 Product Data															
			Installation	3.1	FIO													
			Waste Water Disposal Method		G	RE												
			Satisfactory Installation		FIO													
			SD-06 Test Reports															
			Bacteriological Disinfection		G	RE												
			SD-07 Certificates															
			Installation	3.1	FIO													
			Meters	2.9.8	FIO													
		02513	SD-03 Product Data															
			Job Mix Formula (JMF)		G	RE												
			Aggregrates		G	RE												
			Bituminous Material		G	RE												
			SD-06 Test Reports															
			Test		FIO													
		02531	SD-07 Certificates															
			Portland Cement	2.7.1	FIO													
		02630	SD-03 Product Data															
			Placing Pipe	3.3	FIO													
			SD-07 Certificates															
			Resin Certification	2.1.8	FIO													
			Pipeline Testing	3.8	FIO													
			Hydrostatic Test on Watertight		FIO													
			Joints															
			Determination of Density	3.7.5	FIO													

SUBMITTAL REGISTER

CONTRACT NO. DACA27-03-B-0004

TITLE AND LOCATION: FT. STORY

CONTRACTOR

ACTIVITY NO (a)	TRANSMITTAL NO (b)	SPEC SECT (c)	DESCRIPTION ITEM SUBMITTED (d)	PARAG # RAPH (e)	CLASSIFICATION (f)	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT (g)	APPROVAL NEEDED BY (h)	MATERIAL NEEDED BY (i)	CONTRACTOR ACTION CODE (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR (l)	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	ACTION CODE (o)	DATE OF ACTION (p)	MAILED TO CONTR/ DATE RCD FRM APPR AUTH (q)	REMARKS (r)
		02630	Frame and Cover for Gratings	2.3.7	FIO													
		02722	SD-03 Product Data															
			Plant, Equipment, and Tools	1.7	FIO													
			SD-06 Test Reports															
			Sampling and testing	1.5	G RE													
			Field Density Tests	1.5.2.4	G RE													
		02748	SD-06 Test Reports															
			Sampling and Testing	3.7	FIO													
		02763	SD-03 Product Data															
			Equipment	1.5	FIO													
			Composition Requirements		G RE													
			Qualifications		FIO													
			SD-06 Test Reports															
			Sampling and Testing		FIO													
			SD-07 Certificates															
			Volatile Organic Compound		FIO													
			(VOC)															
		02811	SD-02 Shop Drawings															
			Sprinkler System	3.1	G RE													
			SD-03 Product Data															
			Framed Instructions	3.3	G RE													
			Field Training		G RE													
			Sprinkler System	3.1	G RE													
			Spare Parts		G RE													
			Design Analysis and Calculations		G RE													
			SD-06 Test Reports															

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		02811	Field Tests	3.2	G	RE												
			SD-07 Certificates															
			Sprinkler System	3.1	G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Sprinkler System	3.1	G	RE												
		02821	SD-07 Certificates															
			Chain Link Fence	2.1.1	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Electro-Mechanical Locks	2.11	G	RE												
			Gate Operator	2.10	G	RE												
		02840	SD-02 Shop Drawings															
			Installation	3.1	G	RE												
			Equipment		G	RE												
			SD-03 Product Data															
			Vehicle Barriers		G	RE												
			Spare Parts	1.6	G	RE												
			SD-06 Test Reports															
			Field Testing	3.4	G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Vehicle Barriers		G	RE												
			Operating and Maintenance	3.5	G	RE												
			Instructions															
		02870	SD-02 Shop Drawings															

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		02870	Site Furnishing Standards	2.5	G	RE												
			SD-03 Product Data															
			Site Furnishings	1.4	G	RE												
			Installation	3.1	G	RE												
			Materials	2.1	G	RE												
			SD-04 Samples															
			Finish	2.4	G	RE												
		02921	SD-03 Product Data															
			Equipment		FIO													
			Surface Erosion Control Material	2.8	FIO													
			Delivery	1.4.1	FIO													
			Finished Grade and Topsoil	3.2.1	FIO													
			Topsoil	2.2	FIO													
			Quantity Check	3.5	FIO													
			Seed Establishment Period	3.9	FIO													
			Maintenance Record	3.9.3.5	FIO													
			SD-06 Test Reports															
			Equipment Calibration	3.1.3	FIO													
			Soil Test	3.1.4	G	RE												
			SD-07 Certificates															
			Seed	2.1	G	RE												
			Topsoil	2.2	FIO													
			pH Adjuster	2.3.1	FIO													
			Fertilizer	2.3.2	FIO													
			Organic Material	2.3.4	FIO													
			Soil Conditioner	2.3.5	FIO													

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		02921	Mulch	2.4	FIO													
			Asphalt Adhesive	2.5	FIO													
		02922	SD-03 Product Data															
			Equipment	3.1.3	FIO													
			Delivery	1.4.1	FIO													
			Finished Grade and Topsoil	3.2.1	FIO													
			Topsoil	2.2	FIO													
			Quantity Check	3.5	FIO													
			Sod Establishment Period	3.9	FIO													
			Maintenance Record	3.9.3.5	FIO													
			SD-06 Test Reports															
			Equipment Calibration	3.1.3	FIO													
			Soil Test	3.1.4	G RE													
			SD-07 Certificates															
			Sod	2.1	FIO													
			Topsoil	2.2	FIO													
			pH Adjuster	2.3.1	FIO													
			Fertilizer	2.3.2	FIO													
			Organic Material	2.3.4	FIO													
			Soil Conditioner		FIO													
		02930	SD-02 Shop Drawings															
			Shop Drawings	3.3.1	G RE													
			Finished Grade, Topsoil and	3.2.1	G RE													
			Underground Utilities															
			SD-03 Product Data															
			Geotextile	2.5	G RE													

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		02930	Chemical Treatment Material	1.4.3.2	G	RE												
			Equipment	3.7.2	G	RE												
			Delivery	1.4.1	G	RE												
			Plant Establishment Period	3.9	G	RE												
			Maintenance Record	3.9.2.6	G	RE												
			Application of Pesticide	3.7	G	RE												
			SD-04 Samples															
			Delivered Topsoil	1.4.1.3	G	RE												
			Soil Amendments	3.1.4.2	G	RE												
			Mulch	2.4	G	RE												
			Geotextile	2.5	G	RE												
			SD-06 Test Reports															
			Soil Test	3.1.4.2	G	RE												
			Percolation Test	3.1.4.1	G	RE												
			SD-07 Certificates															
			Plant Material	2.1	G	RE												
			Topsoil	2.2	G	RE												
			pH Adjuster	2.3.1	G	RE												
			Fertilizer	2.3.2	G	RE												
			Organic Material	2.3.3	G	RE												
			Soil Conditioner	2.3.4	G	RE												
			Organic Mulch	2.4.2	G	RE												
			Mycorrhizal Fungi Inoculum	2.12	G	RE												
			Pesticide	2.14	G	RE												
			SD-10 Operation and Maintenance Data															

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		02930	Maintenance Instructions	3.9.5	G	RE												
		02935	SD-03 Product Data															
			Chemical Treatment Material	1.3.3	G	RE												
			Work Plan and Schedule		G	RE												
			Delivery Schedule	1.3.1	G	RE												
			Maintenance Record	3.6.4	G	RE												
			Application of Pesticide	3.5	G	RE												
			SD-06 Test Reports															
			Soil Tests	3.1	G	RE												
			Percolation Test		G	RE												
			SD-07 Certificates															
			Fertilizer		G	RE												
			Mulch	2.2	G	RE												
			Pesticide	2.4	G	RE												
		03150	SD-03 Product Data															
			Preformed Expansion Joint Filler	2.2	FIO													
			Sealant	2.3	FIO													
			Waterstops	2.4	FIO													
		03200	SD-02 Shop Drawings															
			Reinforcement	3.1	G	RE												
			SD-07 Certificates															
			Reinforcing Steel	2.3	FIO													
		03300	SD-03 Product Data															
			Mixture Proportions	1.9	G	RE												
			Lightweight Aggregate Concrete	3.4	G	RE												
			SD-06 Test Reports															

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		03300	Testing and Inspection for	3.17	G	RE												
			Contractor Quality Control															
		03413	SD-02 Shop Drawings															
			Architectural Concrete System		G	RE												
			SD-03 Product Data															
			Calculations	1.4.5	G	RE												
			Mix Design		G	RE												
			Manufacturer's Qualifications		G	RE												
			SD-04 Samples															
			Precast Concrete Units	2.2	G	RE												
			SD-06 Test Reports															
			Materials	2.1	G	RE												
		04200	SD-02 Shop Drawings															
			Masonry Work		G	RE												
			SD-03 Product Data															
			Clay or Shale Brick	2.2	G	RE												
			Prefaced Concrete Masonry Units	2.5	G	RE												
			Insulation	2.17	G	RE												
			Ground Face Concrete Masonry		G	RE												
			Units															
			Cold Weather Installation	3.1.2	G	RE												
			SD-04 Samples															
			Ground Face Concrete Masonry		G	RE												
			Units (CMU)															
			Concrete Masonry Units (CMU)	2.4	G	RE												
			Prefaced Concrete Masonry Units	2.5	G	RE												

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		04200	Clay or Shale Brick	2.2	G	RE												
			Anchors, Ties, and Bar	2.12	G	RE												
			Positioners															
			Expansion-Joint Material		G	RE												
			Joint Reinforcement	2.13	G	RE												
			Insulation	2.17	G	RE												
			Portable Panel		G	RE												
			SD-06 Test Reports															
			Efflorescence Test	3.26.3	G	RE												
			Field Testing of Mortar	3.26.1	G	RE												
			Field Testing of Grout	3.26.2	G	RE												
			Prism tests	3.26.4	G	RE												
			Masonry Cement		G	RE												
			Fire-rated CMU	2.4.3	G	RE												
			Special Inspection	1.5	G	RE												
			SD-07 Certificates															
			Clay or Shale Brick	2.2	G	RE												
			Concrete Masonry Units (CMU)	2.4	G	RE												
			Prefaced Concrete Masonry Units	2.5	G	RE												
			Control Joint Keys	2.15	G	RE												
			Anchors, Ties, and Bar	2.12	G	RE												
			Positioners															
			Expansion-Joint Materials	2.16	G	RE												
			Joint Reinforcement	2.13	G	RE												
			Reinforcing Steel Bars and Rods	2.14	G	RE												
			Masonry Cement		G	RE												

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		04200	Mortar Coloring		G	RE												
			Insulation	2.17	G	RE												
			Precast Concrete Items	2.8	G	RE												
			Mortar Admixtures		G	RE												
			Grout Admixtures		G	RE												
			Ground Face Concrete Masonry Units		G	RE												
		05090	SD-03 Product Data															
			Welding Procedure Qualifications	1.5	G	RE												
			Welder, Welding Operator, and Tacker Qualification	1.6	G	RE												
			Inspector Qualification	1.7	G	RE												
			SD-06 Test Reports															
			Quality Control	3.2	G	RE												
		05120	SD-02 Shop Drawings															
			Structural Steel System		G	AE												
			Structural Connections	3.2.1	G	AE												
			SD-03 Product Data															
			Erection	3.2	G	AE												
			SD-07 Certificates															
			Mill Test Reports		G	AE												
			Welder Qualifications		FIO													
			Welding Inspector	1.5	FIO													
			Fabrication	3.1	FIO													
		05210	SD-02 Shop Drawings															
			Steel Joists	1.3	G	AE												

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		05300	SD-02 Shop Drawings															
			Deck Units	2.1	G RE													
			Accessories	2.5	G RE													
			Attachments	3.3	G RE													
			Holes and Openings	3.4	G RE													
			SD-03 Product Data															
			Deck Units	2.1	G RE													
			Attachments	3.3	G RE													
		05500	SD-02 Shop Drawings															
			Miscellaneous Metal Items	1.6	G RE													
			SD-04 Samples															
			Miscellaneous Metal Items	1.6	G RE													
		06100	SD-02 Shop Drawings															
			Structural Wood Members		G RE													
			Installation of Framing	3.1	G RE													
			Nailers and Nailing Strips	3.6.4	FIO													
			SD-03 Product Data															
			Structural Wood Members		G RE													
			Product Installations		G RE													
			SD-07 Certificates															
			Grading and Marking	2.1.1	G RE													
			Insulation	2.3	G RE													
		06200	SD-02 Shop Drawings															
			Finish Carpentry		G RE													
			SD-03 Product Data															
			Wood Items, Trim	2.1	G RE													

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		06200	SD-04 Samples															
			Trim	2.1.9	G	RE												
		06410	SD-02 Shop Drawings															
			Shop Drawings	1.8	G	RE												
			Installation	3.1	G	RE												
			SD-03 Product Data															
			Wood Materials	2.1	G	RE												
			Wood Finishes		G	RE												
			Finish Schedule	2.12.8.3	G	RE												
			SD-04 Samples															
			Plastic Laminates	2.3	G	RE												
			Cabinet Hardware		G	RE												
			SD-07 Certificates															
			Quality Assurance	1.4	G	RE												
			Laminate Clad Casework	3.1	G	RE												
		06650	SD-02 Shop Drawings															
			Shop Drawings		G	RE												
			Installation	3.2	G	RE												
			SD-03 Product Data															
			Solid polymer material	2.1	G	RE												
			Qualifications	1.6	FIO													
			Fabrications	2.3	FIO													
			SD-04 Samples															
			Material	2.1	G	RE												
			Counter and Vanity Tops	2.3.6	G	RE												
			SD-06 Test Reports															

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		06650	Solid polymer material	2.1	G RE													
			SD-07 Certificates															
			Fabrications	2.3	FIO													
			Qualifications	1.6	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Solid polymer material	2.1	FIO													
			Celean-up		FIO													
		07110	SD-03 Product Data															
			Fibrated Emulsion-Based		FIO													
			Asphalt: Asphaltic Primer; Fibrated															
			Asphalt;															
			SD-07 Certificates															
			Materials		G RE													
		07132	SD-03 Product Data															
			Reinforcing Fabric		FIO													
			Protection Board	3.5.2	FIO													
			Applications		FIO													
			SD-07 Certificates															
			Materials	1.4	FIO													
		07190	SD-03 Product Data															
			Water repellents	2.2	G RE													
			SD-06 Test Reports															
			Water absorption	1.3.2	G RE													
			Accelerated weathering	2.3.4	G RE													

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		07190	Resistance to chloride ion	2.3.4	G	RE												
			penetration															
			Moisture vapor transmission	1.3.2	G	RE												
			Moisture vapor transmission	2.3.4	G	RE												
			Scaling resistance;	2.3.4	G	RE												
			Water Penetration and Leakage	1.3.2	G	RE												
			SD-07 Certificates															
			Manufacturer's qualifications	1.3.1	G	RE												
			Applicator's qualifications	1.3.1	G	RE												
			Evidence of acceptable variation	1.3.3	G	RE												
			Warranty	1.12	G	RE												
			SD-08 Manufacturer’s Instructions															
			Application	3.4	G	RE												
			material safety data sheets	1.7.1	FIO													
		07220	SD-03 Product Data															
			Application of Insulation	3.7	G	RE												
			Inspection	3.8	G	RE												
			SD-07 Certificates															
			Insulation	2.2	G	RE												
			Organic Roofing Felt	2.6	G	RE												
		07410	SD-02 Shop Drawings															
			Panels	2.1	G	RE												
			Fasteners	2.1.5	G	RE												
			Supports	2.1.5	G	RE												
			Flashing	3.1.1	G	RE												
			Closures	3.1.1	G	RE												

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		07410	SD-03 Product Data															
			Panels	2.1	G RE													
			Accessories	2.1.4	G RE													
			Fasteners	2.1.5	G RE													
			warranty	1.7	G RE													
			SD-04 Samples															
			Panels	2.1	G RE													
			SD-06 Test Reports															
			Formability test	1.3.3	G RE													
			Weathering test	1.3.4	G RE													
			Chalking resistance	1.3.5	G RE													
			Color change	1.3.6	G RE													
			Specular gloss	1.3.7	G RE													
			Salt spray test	1.3.8	G RE													
			Abrasion resistance test	1.3.9	G RE													
			Humidity test	1.3.10	G RE													
			Wind uplift	1.3.2	G RE													
			SD-07 Certificates															
			Qualification of installer		G RE													
			Coil Stock		FIO													
		07412	SD-02 Shop Drawings															
			Metal Roofing	1.7.1	G RE													
			SD-04 Samples															
			Accessories	2.2	G RE													
			Roof Panels	2.1	G RE													
			Fasteners	2.3	G RE													

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		07412	Gaskets and Insulating	2.9	G	RE												
			Compounds															
			Sealant	2.8	G	RE												
			SD-07 Certificates															
			Roof Panels	2.1	G	RE												
			Installation	3.1	G	RE												
			Accessories	2.2	G	RE												
			Insulation	2.6	G	RE												
			Installer	1.3.3	G	RE												
			Warranties	1.7	G	RE												
		07551	SD-03 Product Data															
			Acceptable Manufacturer		G	RE												
			Products															
			Johns Manville Roofing System		FIO													
			Group															
			Siplast		FIO													
			Modified Bitumen Roof Manuf.		G	RE												
			Product submitted as an 'or equal'															
			SD-07 Certificates															
			Qualifications		G	RE												
			Materials		G	RE												
			SD-08 Manufacturer’s Instructions															
			Materials and Installation		G	RE												
			Bills of Lading		G	RE												
		07600	SD-02 Shop Drawings															
			Materials	2.1	G	RE												

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		07810	SD-06 Test Reports															
			Spray-applied fireproofing	2.1	G	RE												
			Visual	3.6.2	G	RE												
			SD-08 Manufacturer’s Instructions															
			Manufacturer's inspection	1.4	G	RE												
			Installer qualifications	1.5	G	RE												
		07840	SD-02 Shop Drawings															
			Firestopping Materials	2.1	G	RE												
			SD-07 Certificates															
			Firestopping Materials	2.1	G	RE												
			Installer Qualifications	1.5	FIO													
			Inspection	3.3	G	RE												
		07900	SD-03 Product Data															
			Backing	2.1	G	RE												
			Bond-Breaker	2.2	G	RE												
			Sealant	2.5	G	RE												
			SD-07 Certificates															
			Sealant	2.5	FIO													
		08110	SD-02 Shop Drawings															
			Doors	2.1	G	RE												
			Frames	2.7	G	RE												
			Accessories	2.5	FIO													
			Weatherstripping	2.9	FIO													
			SD-03 Product Data															
			Doors	2.1	G	RE												
			Frames	2.7	G	RE												

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		08110	Accessories	2.5	FIO													
			Weatherstripping	2.9	FIO													
			SD-09 Manufacturer's Field															
			Reports															
			Fire Rated Doors		G RE													
			Fire Rated Doors		G RE													
			Thermal Insulated Doors		G RE													
		08120	SD-02 Shop Drawings															
			Doors and frames	2.1	G RE													
			SD-03 Product Data															
			Aluminum Doors and Frames		G RE													
			SD-04 Samples															
			Finishes		G RE													
			SD-06 Test Reports															
			Aluminum Doors		FIO													
			Formability test	1.2.4	FIO													
			Weathering test	1.2.5	FIO													
			Chalking resistance	1.2.6	FIO													
			Color change	1.2.7	FIO													
			Specular gloss	1.2.8	FIO													
			Salt spray test	1.2.9	FIO													
			Abrasion resistance test	1.2.10	FIO													
			Humidity test	1.2.11	FIO													
			Wind uplift		FIO													
			SD-08 Manufacturer's Instructions															
			Doors and Frames	2.1	G RE													

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		08210	SD-02 Shop Drawings															
			Doors	2.1	G RE													
			Fire Doors		G RE													
			Accessories	2.2	FIO													
			Water-resistant sealer	2.3.7	G RE													
			warranty	1.4	FIO													
			Fire resistance rating	2.1.7	FIO													
			Adhesives		G RE													
			SD-04 Samples															
			Door finish colors	2.3.6.4	FIO													
			Factory-coated natural finish		G RE													
			Samples of factory applied		FIO													
			natural finish															
		08330	SD-02 Shop Drawings															
			Overhead Rolling Door Unit		G RE													
			SD-03 Product Data															
			Overhead Rolling Door Unit		G RE													
			SD-04 Samples															
			Overhead Rolling Door Unit		G RE													
			SD-06 Test Reports															
			Tests	3.3	G RE													
			SD-07 Certificates															
			Fire Doors	2.2	G RE													
			SD-10 Operation and Maintenance															
			Data															
			Operation Manual		FIO													

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		08330	Maintenance and Repair Manual		FIO													
		08331	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1	G RE													
			SD-03 Product Data															
			Rolling Counter Doors		G RE													
			Installation	3.1	G RE													
			Cleaning	3.3	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Operation	2.5	G RE													
		08520	SD-02 Shop Drawings															
			Aluminum Windows		G RE													
			Insect Screens	2.3	G RE													
			SD-03 Product Data															
			Aluminum Windows		G RE													
			SD-04 Samples															
			Aluminum Windows		G RE													
			SD-06 Test Reports															
			Aluminum Windows		FIO													
			Formability test	1.2.7	FIO													
			Weathering test	1.2.8	FIO													
			Chalking resistance	1.2.9	FIO													
			Color change	1.2.10	FIO													
			Specular gloss	1.2.11	FIO													
			Salt spray test	1.2.12	FIO													
			Abrasion resistance test	1.2.13	FIO													

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		08520	Humidity test	1.2.14	FIO													
			Wind uplift		FIO													
			SD-07 Certificates															
			Aluminum Windows		FIO													
		08710	SD-02 Shop Drawings															
			Hardware schedule	1.3	G RE													
			Keying system	2.3.8	G RE													
			SD-03 Product Data															
			Hardware items	2.3	G RE													
			SD-08 Manufacturer's Instructions															
			Installation	3.1	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Hardware Schedule	1.3	G RE													
			SD-11 Closeout Submittals															
			Key bitting	1.4	FIO													
		08810	SD-02 Shop Drawings															
			Installation	3.2	G RE													
			SD-03 Product Data															
			Insulating Glass	2.3	FIO													
			Glazing Accessories	2.11	FIO													
			SD-04 Samples															
			Insulating Glass	2.3	G RE													
			SD-07 Certificates															
			Insulating Glass	2.3	FIO													
			Glazing Accessories	2.11	FIO													

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		08900	SD-02 Shop Drawings															
			Glazed curtain wall system	1.5	G RE													
			SD-03 Product Data															
			Glazed curtain wall system	1.5	G RE													
			SD-05 Design Data															
			Calculations	1.3	G RE													
			SD-06 Test Reports															
			Formability test	1.4.3.7	FIO													
			Weathering test	1.4.3.8	FIO													
			Chalking resistance	1.4.3.9	FIO													
			Color change	1.4.3.10	FIO													
			Specular gloss	1.4.3.11	FIO													
			Salt spray test	1.4.3.12	FIO													
			Abrasion resistance test	1.4.3.13	FIO													
			Humidity test	1.4.3.14	FIO													
			Wind uplift		FIO													
			SD-08 Manufacturer's Instructions															
			Glazed curtain wall system	1.5	FIO													
			Insulating glass		FIO													
		09100	SD-02 Shop Drawings															
			Metal support systems	2.1	G RE													
			SD-07 Certificates															
			Metal support systems	2.1	G RE													
		09250	SD-03 Product Data															
			Water Resistant Gypsum Backing Board	2.1.3	G RE													

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		09250	Accessories	2.1.14	G	RE												
			Gypsum Wallboard		G	RE												
			Cementitious Backer Units	2.1.8	G	RE												
			SD-07 Certificates															
			Asbestos Free Materials	2.1	G	RE												
		09310	SD-03 Product Data															
			Tile	2.1	G	RE												
			Setting-Bed	2.2	G	RE												
			Mortar, Grout, and Adhesive	2.4	G	RE												
			SD-04 Samples															
			Tile	2.1	G	RE												
			Accessories		G	RE												
			Marble Thresholds	2.5	G	RE												
			SD-07 Certificates															
			Tile	2.1	FIO													
			Mortar, Grout, and Adhesive	2.4	FIO													
		09510	SD-02 Shop Drawings															
			Approved Detail Drawings	1.3	G	RE												
			SD-03 Product Data															
			Acoustical Ceiling Systems		G	RE												
			SD-04 Samples															
			Acoustical Units	2.1	G	RE												
			SD-06 Test Reports															
			Ceiling Attenuation Class and		G	RE												
			Test															
			SD-07 Certificates															

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		09510	Acoustical Units	2.1	FIO													
		09650	SD-03 Product Data															
			Resilient Flooring and		G	RE												
			Accessories															
			SD-04 Samples															
			Flooring	3.2	G	RE												
			SD-06 Test Reports															
			Moisture Test	3.3	G	RE												
		09680	SD-02 Shop Drawings															
			Installation	3.4	G	RE												
			Molding	2.3	G	RE												
			SD-03 Product Data															
			Carpet		G	RE												
			Surface Preparation	3.1	G	RE												
			Installation	3.4	G	RE												
			Regulatory Requirements	1.4	G	RE												
			SD-04 Samples															
			Carpet		G	RE												
			Molding	2.3	G	RE												
			SD-06 Test Reports															
			Moisture and Alkalinity Tests	3.2	G	RE												
			SD-07 Certificates															
			Carpet		G	RE												
			Regulatory Requirements	1.4	G	RE												
			SD-10 Operation and Maintenance															
			Data															

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		09680	Carpet		G RE													
			Cleaning and Protection	3.5	FIO													
		09697	SD-04 Samples															
			Walk-Off Mat		G RE													
			Walk-Off Mat		FIO													
		09900	SD-02 Shop Drawings															
			Piping identification	3.12	G RE													
			stencil	3.12	G RE													
			SD-03 Product Data															
			Coating	2.1	G RE													
			Manufacturer's Technical Data	2.1	FIO													
			Sheets															
			SD-04 Samples															
			Color	1.9	G RE													
			SD-07 Certificates															
			Applicator's qualifications	1.3	FIO													
			Qualification Testing	1.4.1.2	G RE													
			SD-08 Manufacturer’s Instructions															
			Application instructions		G RE													
			Mixing	3.8.2	G RE													
			Manufacturer's Material Safety	1.7.2	FIO													
			Data Sheets															
			SD-10 Operation and Maintenance															
			Data															
			Coatings:	2.1	G RE													
		09915	SD-04 Samples															

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		09915	Contractor Color board		FIO													
			Manufacturer's Products		G RE													
			Submitted as an 'Equal'															
		10100	SD-03 Product Data															
			Visual Display Boards		FIO													
			SD-04 Samples															
			Aluminum	2.2.6	G RE													
			Porcelain Enamel	2.2.1	G RE													
			Materials	2.2	G RE													
			SD-07 Certificates															
			Visual Display Boards		FIO													
		10106	SD-02 Shop Drawings															
			Display Case		G RE													
			SD-03 Product Data															
			Display Cases. See Section		FIO													
			COLOR SCHEDULE		FIO													
			Display Case Manuf. Product		FIO													
			submitted as an 'or equal'															
		10160	SD-02 Shop Drawings															
			Toilet Partition System		G RE													
			SD-03 Product Data															
			Toilet Partition System		G RE													
			SD-04 Samples															
			Toilet Partition System		G RE													
		10201	SD-02 Shop Drawings															
			Wall louvers	2.2	G RE													

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		10201	SD-04 Samples															
			Wall louvers	2.2	G RE													
		10260	SD-02 Shop Drawings															
			Corner Guards	2.2	G RE													
			Wall Guards (Bumper Guards)	2.3	G RE													
			SD-03 Product Data															
			Corner Guards	2.2	G RE													
			Wall Guards (Bumper Guards)	2.3	G RE													
			SD-04 Samples															
			Finish	2.7	G RE													
			SD-06 Test Reports															
			Corner Guards	2.2	G RE													
			Wall Guards (Bumper Guards)	2.3	G RE													
			SD-07 Certificates															
			Corner Guards	2.2	FIO													
			FIO		FIO													
			Wall Guards (Bumper Guards)	2.3	FIO													
		10430	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1	G RE													
			SD-03 Product Data															
			Modular Exterior Signage System	2.1	G RE													
			Installation	3.1	FIO													
			Exterior Signs		G RE													
			Wind Load Requirements	1.3	FIO													
			SD-04 Samples															
			Exterior Signs		G RE													

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		10430	SD-10 Operation and Maintenance															
			Data															
			Protection and Cleaning	3.1.2	FIO													
		10440	SD-02 Shop Drawings															
			Detail Drawings	3.1	G	RE												
			SD-03 Product Data															
			Installation	3.1	G	RE												
			SD-04 Samples															
			Interior Signage	1.3	G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Approved Manufacturer's	3.1	G	RE												
			Instructions															
			Protection and Cleaning	3.1.2	G	RE												
		10508	SD-03 Product Data															
			Lockers: See Section 09915		G	RE												
			COLOR SCHEDULE.															
			Locker Manuf. Product submitted		G	RE												
			as an 'or equal'															
			Bench Seat: See Section		FIO													
			COLOR SCHEDULE		G	RE												
			Bench Seat Manuf. Product		G	RE												
			submitted as an 'or equal'															
			SD-02 Shop Drawings															
			Shop Drawings.		G	RE												
			SD-04 Samples															

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		10508	Samples		G RE													
		10522	SD-01 Preconstruction Submittals															
			Fire Extinguisher Cabinet Product Data		G RE													
			Maintenance Data		FIO													
			Acceptable Manufacturer Products		FIO													
			FEC: J. L. Industries		FIO													
			FEC: Larsen's Manufacturing Company		FIO													
			FEC: Potler-Roemer		FIO													
			FEC: Manuf. Product submitted as an 'or equal'; G. RE.		FIO													
			SD-04 Samples															
			Shop Drawings		FIO													
		10530	SD-02 Shop Drawings															
			Mail Boxes		G RE													
			Mooring Eye Floor Casting		G RE													
			SD-03 Product Data															
			Acceptable Manufacturer Products		FIO													
			Mail Boxes: See Section 09915 COLOR SCHEDULE		FIO													
			Mail Box Manuf.		G RE													

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		10530	Mooring Eye Floor Casting:		FIO													
			Neenah Foundry Co. No.															
			R-3490-F.															
			Mooring Eye Manuf. Product		G RE													
			submitted as an 'or equal'															
			SD-04 Samples															
			Color Charts		FIO													
		10552	SD-02 Shop Drawings															
			Shop Drawings		G RE													
			SD-03 Product Data															
			Acceptable Manufacturer		FIO													
			Products															
			Shelving: Penco Products Inc.		FIO													
			Shelving: Republic Storage		FIO													
			Systems Co., Inc.															
			Shelving: Manuf. Product		FIO													
			submitted as an 'or equal'; G. RE.															
			SD-04 Samples															
			Metal Shelving		G RE													
		10605	SD-02 Shop Drawings															
			Wire mesh partitions	1.4	G RE													
			SD-03 Product Data															
			Wire mesh partitions	1.4	G RE													
		10753	SD-02 Shop Drawings															
			Shop Drawings		G RE													
			SD-03 Product Data															

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		10753	Acceptable Manufacturer		FIO													
			Products															
			American Specialties, Inc.		FIO													
			Product: Tellette 1310-SH															
			PBG, Inc. Product: PB-101/Indoor		FIO													
			Enclosure															
			Redy Ref Pressed & Welded, Inc.		FIO													
			Product: MS 2200-CF															
			Telephone Encl., Manuf. Product		G RE													
			submitted as an 'or equal'															
			SD-07 Certificates															
			Certificate		FIO													
		10800	SD-03 Product Data															
			Toilet and Shower Accessories		G RE													
			Acceptable Manufacturer		FIO													
			Products															
			Bobrick Washroom Equipment,		FIO													
			Inc.															
			Toilet and Bath Manuf. Products		FIO													
			submitted as an 'or equal'; G, RE.															
			SD-08 Manufacturer's Instructions															
			Toilet and Bath Accessories		FIO													
		11020	SD-03 Product Data															
			Vault Door and Frame	2.1	G RE													
			SD-07 Certificates															
			Vault Door and Frame	2.1	G RE													

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		11165	SD-02 Shop Drawings															
			Bumper		FIO													
			SD-03 Product Data															
			Acceptable Manufacturer		FIO													
			Products															
			Durable Corporation		FIO													
			Xtreme Needs		FIO													
			Pioneer Manufacturing, Inc		G RE													
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Installation		FIO													
			Instructions															
		11400	SD-02 Shop Drawings															
			Food Service Equipment	2.1.6	G RE													
			Installation	3.1	G RE													
			SD-03 Product Data															
			Food Service Equipment	2.1.6	FIO													
			SD-06 Test Reports															
			Testing	3.3	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Food Service Equipment	2.1.6	FIO													
			SD-02 Shop Drawings															
			Food Service Equipment	2.1.6	G RE													
			Installation	3.1	G RE													
			SD-03 Product Data															
			Food Service Equipment	2.1.6	FIO													

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		11400	SD-06 Test Reports															
			Testing	3.3	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Food Service Equipment	2.1.6	FIO													
		11401	SD-03 Product Data															
			Kitchen equipment	2.1	G RE													
			SD-08 Manufacturer's Instructions															
			Kitchen equipment	2.1	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Kitchen equipment	2.1	FIO													
		12320	SD-02 Shop Drawings															
			Installation	3.1	G RE													
			SD-03 Product Data															
			Cabinets	2.1	FIO													
			Countertops and Backsplash	2.2	FIO													
			SD-04 Samples															
			Cabinets	2.1	G RE													
			Countertops and Backsplash	2.2	G RE													
			SD-06 Test Reports															
			Cabinets and Countertops		FIO													
		12350	SD-02 Shop Drawings															
			Approved Detail Drawings	2.1	G RE													
			SD-03 Product Data															
			Casework	2.1	G RE													

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		12350	SD-04 Samples															
			Casework	2.1	G RE													
			SD-07 Certificates															
			Casework	2.1	FIO													
		12490	SD-02 Shop Drawings															
			Approved Detail Drawings	3.2	G RE													
			SD-03 Product Data															
			Window Treatments	3.2	G RE													
			Hardware	1.3	G RE													
			SD-04 Samples															
			Window Treatments	3.2	G RE													
		13100	SD-02 Shop Drawings															
			Drawings		G RE													
			SD-07 Certificates															
			Materials	2.1	G RE													
		13110	SD-02 Shop Drawings															
			Drawings	1.3.5	G RE													
			Drawings	1.3.7	G RE													
			Drawings	1.3.9	G RE													
			SD-03 Product Data															
			Equipment	2.2.12.2	G RE													
			Equipment	3.5.5.5	G RE													
			Spare Parts	3.9	G RE													
			SD-06 Test Reports															
			Tests and Measurements	3.5	G RE													
			SD-07 Certificates															

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		13110	Cathodic Protection System	1.3.8	G	RE												
			Cathodic Protection System	2.2.8	G	RE												
			Services of 'Corrosion Expert'	1.3.1	G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Cathodic Protection System	1.3.8	G	RE												
			Cathodic Protection System	2.2.8	G	RE												
			Training Course	3.6	G	RE												
		13121	SD-02 Shop Drawings															
			Drawings		G	RE												
			SD-03 Product Data															
			Manufacturer's Instructions	3.1.6	G	RE												
			Qualifications	1.3.2	G	RE												
			SD-07 Certificates															
			Metal Building Systems		G	RE												
			Insulation	2.7	G	RE												
		13720	SD-03 Product Data															
			Manufacturer's Data		G	RE												
			Software Data		FIO													
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance Data		G	RE												
			Hardware Manual		G	RE												
			Software Manual		G	RE												
			Operator's Manual		G	RE												
			Maintenance Manual		G	RE												

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		13851	SD-02 Shop Drawings															
			Fire Alarm Reporting System	1.4.1	G	AE												
			SD-03 Product Data															
			Storage Batteries	2.2	G	RE												
			Voltage Drop		FIO													
			Special Tools and Spare Parts	2.7.4	FIO													
			Technical Data and Computer Software	1.5	G	RE												
			Training	3.6	FIO													
			Fire Alarm Test Plan		G	RE												
			SD-06 Test Reports															
			Testing	3.5	FIO													
			SD-07 Certificates															
			Equipment		G	RE												
			Qualifications	1.3.7	G	RE												
			SD-10 Operation and Maintenance Data															
			Technical Data and Computer Software	1.5	G	RE												
		13930	SD-02 Shop Drawings															
			Sprinkler System Shop Drawings		G	AE												
			As-Built Shop Drawings		G	AE												
			SD-03 Product Data															
			Fire Protection Related Submittals	3.1	G	AE												

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		13930	Load Calculations for Sizing Sway Bracing		G AE												
			Components and Equipment Data		G AE												
			Hydraulic Calculations	1.7	G AE												
			Spare Parts		FIO												
			Preliminary Tests Procedures		G RE												
			Final Acceptance Test Procedures		G RE												
			On-site Training Schedule		G RE												
			Preliminary Tests	3.10	G AE												
			Final Acceptance Test		G AE												
			Fire Protection Specialist Qualifications		FIO												
			Sprinkler System Installer Qualifications	1.9	FIO												
			SD-06 Test Reports														
			Preliminary Tests Report		G AE												
			Final Acceptance Test Report		G AE												
			SD-07 Certificates														
			Fire Protection Specialist Inspection		FIO												
			SD-10 Operation and Maintenance Data														
			Wet Pipe Sprinkler System		G AE												
		13965	SD-02 Shop Drawings														

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		13965	Wet Chemical Fire Extinguishing		G	AE												
			System															
			SD-03 Product Data															
			Similar Services		G	AE												
			Wet Chemical Fire Extinguishing		G	AE												
			System															
			Preliminary Tests	3.2	G	AE												
			Final Acceptance Tests	3.3	G	AE												
			System Diagrams		G	RE												
			Test Schedule		G	RE												
			Field Training	3.4	G	RE												
			SD-06 Test Reports															
			Preliminary Tests	3.2	G	RE												
			Final Acceptance Tests	3.3	G	RE												
			SD-07 Certificates															
			Installation Technician	1.3.4	G	RE												
			Installation Drawings	1.3.3	G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Wet Chemical Fire Extinguishing		G	RE												
			System															
		14240	SD-02 Shop Drawings															
			Elevator System		G	RE												
			SD-03 Product Data															
			Training Data		FIO													
			Elevator System		G	RE												

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		14240	Framed Instructions	3.7	FIO													
			Test Procedures		G	RE												
			SD-04 Samples															
			Finishes		G	RE												
			SD-06 Test Reports															
			Testing	3.6	FIO													
			SD-07 Certificates															
			Qualification Certificates		FIO													
			SD-10 Operation and Maintenance															
			Data															
			Elevator System		G	RE												
		15080	SD-04 Samples															
			Thermal Insulation Materials		G	RE												
		15181	SD-02 Shop Drawings															
			Piping System	2.4	G	RE												
			SD-03 Product Data															
			Piping System	2.4	G	RE												
			Water Treatment Systems	2.12	FIO													
			Spare Parts		FIO													
			Qualifications	1.3	FIO													
			Field Tests	3.3	FIO													
			Verification of Dimensions	1.6.1	FIO													
			SD-06 Test Reports															
			Field Tests	3.3	FIO													
			SD-07 Certificates															
			Service Organization	2.1	FIO													

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		15181	SD-10 Operation and Maintenance															
			Data															
			Operation Manuals		G	RE												
			Maintenance Manuals		G	RE												
		15182	SD-02 Shop Drawings															
			Refrigerant Piping System	2.3	G	RE												
			SD-03 Product Data															
			Refrigerant Piping System	2.3	G	RE												
			Spare Parts		FIO													
			Qualifications	1.3	FIO													
			Refrigerant Piping Tests	3.3	FIO													
			Demonstrations		FIO													
			Verification of Dimensions	1.6.1	FIO													
			SD-06 Test Reports															
			Refrigerant Piping Tests	3.3	FIO													
			SD-07 Certificates															
			Service Organization	2.1	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Operation Manuals		FIO													
			Maintenance Manuals		FIO													
		15190	SD-02 Shop Drawings															
			Gas Piping System	3.2	G	RE												
			SD-03 Product Data															
			Qualifications		FIO													
			SD-06 Test Reports															

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		15190	Testing		FIO													
			Pressure Tests	3.16.1	FIO													
			Pressure Tests for Liquified	3.16.2	FIO													
			Petroleum Gas															
			Test With Gas	3.16.3	FIO													
		15400	SD-02 Shop Drawings															
			Plumbing System	3.9.1	G RE													
			Electrical Schematics		FIO													
			SD-03 Product Data															
			Welding	1.5.1	FIO													
			Plumbing Fixture Schedule	3.10	G RE													
			Vibration-Absorbing Features	3.4	FIO													
			Plumbing System	3.9.1	FIO													
			SD-06 Test Reports															
			Tests, Flushing and Disinfection	3.9	FIO													
			Backflow Prevention Assembly		FIO													
			Tests															
			SD-07 Certificates															
			Materials and Equipment		FIO													
			Bolts	2.1.1	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Plumbing System	3.9.1	FIO													
		15565	SD-02 Shop Drawings															
			Heating System		FIO													
			Installation	3.1	FIO													

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		15565	SD-03 Product Data															
			Heating System		G RE													
			INDIRECT FIRED MAKE-UP AIR		FIO													
			UNIT, Reznor, Model SCE															
			INDIRECT FIRED MAKE-UP AIR		G RE													
			UNIT, Manuf. Prod. submitted as															
			an 'or equal'															
			SD-06 Test Reports															
			Testing, Adjusting, and Balancing	3.2	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Instructions	3.3	FIO													
		15569	SD-02 Shop Drawings															
			Heating System		G RE													
			Piping Installation	3.2	G RE													
			Installation	3.2.6.4	FIO													
			Installation	3.2.12	FIO													
			SD-03 Product Data															
			FINNED WATER TUBE BOILERS,		FIO													
			Lochinvar, Inc., Model Copper-Fin II															
			FINNED WATER TUBE BOILERS,		G RE													
			Manufacturer Product submitted as															
			an 'or equal'															
			CONDENSING BOILER,		FIO													
			HydroTherm Corp., Model AM-100															

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		15569	CONDENSING BOILER..Manuf.		G RE													
			Prod. submitted as an 'or equal'															
			Manufacturer's Catalog Data		G RE													
			Spare Parts Data		FIO													
			Water Treatment Plan		FIO													
			Boiler Water Treatment	2.15	FIO													
			Heating System Tests	3.8	FIO													
			Fuel System Tests	3.10	FIO													
			Welding	1.3.6	FIO													
			Qualification		FIO													
			Field Instructions	3.11	FIO													
			Tests	3.3	FIO													
			SD-06 Test Reports															
			Heating System Tests	3.8	FIO													
			Fuel System Tests	3.10	FIO													
			Water Treatment Tests		FIO													
			SD-07 Certificates															
			Bolts	2.10,12.3	FIO													
			Continuous Emissions		FIO													
			Monitoring															
			SD-10 Operation and Maintenance															
			Data															
			Heating System		FIO													
			Water Treatment System		FIO													
		15620	SD-02 Shop Drawings															
			Drawings		G RE													

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		15620	Installation	3.1	G	RE												
			SD-03 Product Data															
			Refrigeration System	3.1.1	G	RE												
			Spare Parts		FIO													
			Posted Instructions	3.5	FIO													
			Verification of Dimensions	1.5.1	FIO													
			Manufacturer's Multi-Year	1.6	FIO													
			Compressor Warranty															
			System Performance Tests	3.1.1.2	FIO													
			System Performance Tests	3.4	FIO													
			Demonstrations	3.5	FIO													
			SD-06 Test Reports															
			System Performance Tests	3.1.1.2	FIO													
			System Performance Tests	3.4	FIO													
			SD-07 Certificates															
			Refrigeration System	3.1.1	FIO													
			Service Organization	2.1	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Operation Manuals		G	RE												
			Maintenance Manuals	3.5	G	RE												
		15700	SD-02 Shop Drawings															
			Drawings		G	RE												
			SD-03 Product Data															
			Unitary Equipment	2.4	G	RE												
			Unitary Equipment	2.6	G	RE												

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		15700	Spare Parts Data		FIO													
			Posted Instructions	3.5	FIO													
			Verification of Dimensions	1.5.1	FIO													
			System Performance Tests	3.4	FIO													
			Demonstrations	3.5	G RE													
			SD-06 Test Reports															
			Refrigerant Tests, Charging, and	3.3	G RE													
			Start-Up															
			System Performance Tests	3.4	G RE													
			SD-07 Certificates															
			Unitary Equipment	2.4	FIO													
			Unitary Equipment	2.6	FIO													
			Service Organization	2.1	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Operation Manuals		FIO													
			Maintenance Manuals	3.5	FIO													
		15895	SD-02 Shop Drawings															
			Drawings	3.1.9	G RE													
			Installation	3.1	G RE													
			SD-03 Product Data															
			Components and Equipment	2.1	G RE													
			Test Procedures	2.11.1	FIO													
			Welding Procedures	3.1.1.1	FIO													
			System Diagrams		G RE													
			Similar Services		FIO													

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		15895	Welding Joints		FIO													
			Testing, Adjusting and Balancing	3.6	FIO													
			Field Training	3.8	FIO													
			SD-06 Test Reports															
			Performance Tests	3.7	FIO													
			SD-07 Certificates															
			Bolts	2.5.2.2	FIO													
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.8	FIO													
			Instructions															
		15940	SD-02 Shop Drawings															
			Exhaust System Drawings		FIO													
			Exhaust System Installation	3.4	FIO													
			SD-03 Product Data															
			Exhaust System Related	3.1	G	RE												
			Submittals															
			Ductwork Components	2.6	G	RE												
			Materials and Equipment	2.9	G	RE												
			Spare Parts		FIO													
			Field Instructions	3.7	FIO													
			Final Acceptance Tests	3.6	FIO													
			On-site Training	3.7	G	RE												
			Exhaust System Specialist	1.7	G	RE												
			SD-06 Test Reports															
			Final Acceptance Tests	3.6	FIO													

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		15940	SD-07 Certificates															
			Inspection by Exhaust System Specialist	3.3	FIO													
			SD-10 Operation and Maintenance Data															
			Exhaust System		FIO													
			Operation and Maintenance Manuals	3.7	FIO													
		15951	SD-02 Shop Drawings															
			HVAC Control System	3.1.1	G	RE												
			SD-03 Product Data															
			Service Organizations		G	RE												
			Equipment Compliance Booklet	1.6	G	RE												
			Commissioning Procedures	3.4	G	RE												
			Performance Verification Test Procedures	1.6	G	RE												
			Training	3.6	G	RE												
			Preventive Maintenance Software		G	RE												
			SD-06 Test Reports															
			Commissioning Report	3.6.2	G	RE												
			Performance Verification Test	3.5.3	G	RE												
			SD-10 Operation and Maintenance Data															
			Operation Manual	1.5	G	RE												
			Maintenance and Repair Manual	1.6	G	RE												
		15990	SD-02 Shop Drawings															

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		15990	TAB Schematic Drawings and Report Forms	3.3	G RE													
			SD-03 Product Data															
			TAB Related HVAC Submittals	3.2	FIO													
			TAB Procedures	3.5.1	G RE													
			Calibration	1.4	FIO													
			Systems Readiness Check	3.5.2	FIO													
			TAB Execution	3.5.1	G RE													
			TAB Verification	3.5.4	G RE													
			SD-06 Test Reports															
			Design Review Report	3.1	G RE													
			Systems Readiness Check	3.5.2	G RE													
			TAB Report	3.5.3	G RE													
			TAB Verification Report	3.5.4	G RE													
			SD-07 Certificates															
			Ductwork Leak Testing		FIO													
			TAB Firm	1.5.1	G RE													
			TAB Specialist	1.5.2	G RE													
		16263	SD-02 Shop Drawings															
			Layout		G RE													
			General Installation	3.1	G RE													
			Acceptance	3.8	G RE													
			SD-03 Product Data															
			Performance Criteria		G RE													
			Sound Limitations		G RE													
			Harmonic Requiremants		G RE													

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		16263	Engine-Generator Parameter	1.3.1	G	RE												
			Schedule															
			Integral Main Fuel Storage Tank	2.3.4	G	RE												
			Day Tank	2.3.5	G	RE												
			Power Factor	3.5.1.2	G	RE												
			Heat Rejected To		G	RE												
			Engine-Generator Space															
			Cooling System	2.5	G	RE												
			Time-Delay on Alarms	2.17.5	G	RE												
			Generator	2.13	G	RE												
			Manufacturer's Catalog	2.2	G	RE												
			Site Welding	1.4.6	G	RE												
			Spare Parts		G	RE												
			Onsite Training	3.7	G	RE												
			Battery Charger	2.11.3.2	G	RE												
			Vibration-Isolation	1.4.11	G	RE												
			Posted Data and Instructions	3.6	G	RE												
			Instructions	3.5.4.1	G	RE												
			Experience	1.4.17	G	RE												
			Field Engineer	1.4.18	G	RE												
			General Installation	3.1	G	RE												
			SD-06 Test Reports															
			Factory Inspection and Tests	2.27	G	RE												
			Factory Tests	2.27.2	G	RE												
			Onsite Inspection and Tests	3.5	G	RE												
			SD-07 Certificates															

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		16263	Vibration Isolation	1.4.11	G	RE												
			Prototype Test	2.27.2	G	RE												
			Reliability and Durability	1.3.4	G	RE												
			Emissions	2.10	G	RE												
			Sound Limitations		G	RE												
			Site Visit		G	RE												
			Flywheel Balance		G	RE												
			Materials and Equipment	2.1	G	RE												
			Inspections	3.5.3	G	RE												
			Cooling System	2.5	G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.7	G	RE												
			Manuals															
			Maintenance Procedures	3.7	G	RE												
			Special Tools	2.12	G	RE												
			Filters	2.4.2	G	RE												
		16370	SD-02 Shop Drawings															
			Electrical Distribution System	3.11.3	G	RE												
			As-Built Drawings		G	RE												
			SD-03 Product Data															
			Fault Current Analysis	2.23.4	G	RE												
			Nameplates	2.3	G	RE												
			Material and Equipment	2.2	G	RE												
			General Installation	3.1	G	RE												
			Requirements															

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		16370	SD-06 Test Reports															
			Factory Tests		G	RE												
			Field Testing	3.11	G	RE												
			Operating Tests	3.11.9	G	RE												
			SD-07 Certificates															
			Material and Equipment	2.2	G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Electrical Distribution System	3.11.3	G	RE												
		16375	SD-02 Shop Drawings															
			Electrical Distribution System	3.11.3	G	RE												
			As-Built Drawings		G	RE												
			SD-03 Product Data															
			Nameplates	2.2	G	RE												
			Material and Equipment	2.1	G	RE												
			General Installation	3.1	G	RE												
			Requirements															
			SD-06 Test Reports															
			Factory Tests	2.17	G	RE												
			Field Testing	3.11	G	RE												
			Operating Tests	3.11.13	G	RE												
			Cable Installation	3.2.1.4	G	RE												
			SD-07 Certificates															
			Material and Equipment	2.1	G	RE												
			Cable Joints	3.3	G	RE												
			Cable Installer Qualifications		G	RE												

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		16375	SD-10 Operation and Maintenance															
			Data															
			Electrical Distribution System	3.11.3	G	RE												
		16415	SD-02 Shop Drawings															
			Interior Electrical Equipment		G	RE												
			SD-03 Product Data															
			As-Built Drawings	1.2.6	G	RE												
			Onsite Tests		G	RE												
			SD-06 Test Reports															
			Factory Test Reports		G	RE												
			Field Test Plan		G	RE												
			Field Test Reports	3.22	G	RE												
			SD-07 Certificates															
			Materials and Equipment	1.4	G	RE												
		16475	SD-03 Product Data															
			Data		G	RE												
			SD-09 Manufacturer's Field															
			Reports															
			Certifications		G	RE												
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance		G	RE												
			Manual															
			SD-11 Closeout Submittals															
			Reports		G	RE												
		16528	SD-02 Shop Drawings															

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		16528	Lighting System	1.3.1	G RE													
			Detail Drawings		G RE													
			As-Built Drawings	3.16.3	G RE													
			SD-03 Product Data															
			Equipment and Materials		G RE													
			SD-10 Operation and Maintenance															
			Data															
			Lighting System	1.3.1	G RE													
		16710	SD-02 Shop Drawings															
			Premises Distribution System	1.7	G RE													
			Record Drawings		G RE													
			SD-03 Product Data															
			Record Keeping and	1.8	G RE													
			Documentation															
			Manufacturer's	3.1.2	G RE													
			Recommendations															
			Test Plan		G RE													
			Qualifications	1.4	G RE													
			SD-06 Test Reports															
			Test Reports		G RE													
			SD-07 Certificates															
			Premises Distribution System	1.7	G RE													
			Materials and Equipment	2.1	G RE													
			Installers		G RE													
		16711	SD-02 Shop Drawings															
			Telephone System		G RE													

SUBMITTAL REGISTER

CONTRACT NO. DACA27-03-B-0004

TITLE AND LOCATION: FT. STORY

CONTRACTOR

ACTIVITY NO (a)	TRANSMITTAL NO (b)	SPEC SECT (c)	DESCRIPTION ITEM SUBMITTED (d)	PARAG # RAPH (e)	CLASSIFICATION (f)	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT (g)	APPROVAL NEEDED BY (h)	MATERIAL NEEDED BY (i)	CONTRACTOR ACTION CODE (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR (l)	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	ACTION CODE (o)	DATE OF ACTION (p)	MAILED TO CONTR/ DATE RCD FRM APPR AUTH (q)	REMARKS (r)
		16711	Installation	3.1	G RE													
			Record Drawings		G RE													
			SD-03 Product Data															
			Spare Parts		G RE													
			Equipment	1.5.2	G RE													
			Installation	3.1	G RE													
			Acceptance Tests	3.5	G RE													
			Cutover and Records	3.4	G RE													
			SD-06 Test Reports															
			Acceptance Tests	3.5	G RE													
			SD-07 Certificates															
			Telephone System		G RE													
			Qualifications	1.4	G RE													
		16768	SD-02 Shop Drawings															
			Fiber Optic System		G RE													
			Installation	3.1	G RE													
			SD-03 Product Data															
			Fiber Optic System		G RE													
			Manufacturer's Instructions	3.1	G RE													
			Test Procedures and reports		G RE													
			SD-06 Test Reports															
			Test Procedures and Reports		G RE													
			SD-07 Certificates															
			Fiber Optic System		G RE													
			SD-10 Operation and Maintenance Data															

SUBMITTAL REGISTER

CONTRACT NO. DACA27-03-B-0004

TITLE AND LOCATION: FT. STORY

CONTRACTOR:

ACTIVITY NO (a)	TRANSMITTAL NO (b)	SPEC SECT (c)	DESCRIPTION ITEM SUBMITTED (d)	PARAGRAPH # (e)	CLASSIFICATION (f)	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES SUBMIT (g)	APPROVAL NEEDED BY (h)	MATERIAL NEEDED BY (i)	CONTRACTOR ACTION CODE (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR (l)	APPROVING AUTHORITY DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	ACTION CODE (o)	DATE OF ACTION (p)	MAILED TO CONTR/ DATE RCD FRM APPR AUTH (q)	REMARKS (r)
		16768	System Maintenance Course		G	RE												

GENERAL DECISION VA020015 03/14/03 VA15

General Decision Number VA020015

Superseded General Decision No. VA010015

State: Virginia

Construction Type:
BUILDING

County(ies):
CHESAPEAKE* PORTSMOUTH* VIRGINIA BEACH*
NORFOLK* SUFFOLK*

*INDEPENDENT CITIES

BUILDING CONSTRUCTION PROJECTS (Does not include single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	03/01/2002
1	03/08/2002
2	06/07/2002
3	06/21/2002
4	11/15/2002
5	11/29/2002
6	01/03/2003
7	01/17/2003
8	03/14/2003

COUNTY(ies):
CHESAPEAKE* PORTSMOUTH* VIRGINIA BEACH*
NORFOLK* SUFFOLK*

BRVA0001A 11/01/2002

	Rates	Fringes
BRICKLAYERS	18.33	5.41

CARP0613G 05/01/2002

	Rates	Fringes
CARPENTERS (Including Drywall Hanging,Acoustical Ceiling and Formsetting)	17.20	4.24+2%

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* ELEC0080D 03/01/2003

	Rates	Fringes
ELECTRICIANS	19.75	3.40+11.25% +a

a. Workmen shall take off 2 hours with pay, at the discretion of the employer, on State and National Election days; Tuesday following the first Monday in November, provided they are qualified and vote.

ELEV0052A 12/13/2001

	Rates	Fringes
ELEVATOR MECHANICS	22.94	7.455+a+b

a. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving, and Christmas Day.

b. VACATIONS: 6% men under 5 (five) years based on regular hourly rate and 8% men over 5 (five) years based on regular hourly rate for all hours worked.

ENGI0147Y 05/01/2002

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
Fork Lifts	15.50	6.43

IRON0079C 05/01/2002

	Rates	Fringes
IRONWORKERS:		
Structural & Reinforcing	19.43	5.06+11.9%

LABO0388A 05/01/2002

	Rates	Fringes
MASON TENDERS, BRICK	11.95	1.90

PAIN0051R 06/16/2001

	Rates	Fringes
PAINTERS, BRUSH AND ROLLER (Including Drywall Finishing)	13.97	4.91

PLUM0110A 05/01/2002

	Rates	Fringes
PLUMBERS & PIPEFITTERS	20.25	8.49

SUVA1109A 11/15/2002

	Rates	Fringes
CEMENT MASONS/FINISHERS	13.79	0.61
LABORERS:		
Unskilled Laborers	8.71	
Fence Erectors	12.93	2.25
Mason Tenders, Cement	8.50	0.24
Pipelayers	10.91	0.79
POWER EQUIPMENT OPERATORS:		
Backhoes	13.27	
Bulldozers	15.00	0.73
Cranes	17.33	
Graders	10.00	
ROOFERS	12.65	0.59
SHEET METAL WORKERS	14.00	0.97
TRUCK DRIVERS, 2 AXLE	12.00	1.25

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

==========

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations

indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

CENAO-TS-EG

Foundation Analysis
USAR Center / OMS / AMSA / Storage
Fort Story, Virginia
Final Report
July 2002

Project Description

The project involves construction of a new USARC facility at Fort Story, Virginia which consists of a two-story 600-member (63,154 square feet) U.S. Army Reserve Center (USARC), an 8,541 square-foot Organizational Maintenance Shop (OMS), and a 3,317 square-foot unheated storage building. The project will include reinforced concrete foundations, concrete floor slabs-on-grade, structural steel frames, masonry veneer exterior walls, and appropriate mechanical electrical systems. The roof system(s) will be standing seam metal. Supporting facilities will include site improvements and relocation of utilities to serve new structures.

Site Description

The site of the proposed USARC facility is located at Fort Story, Virginia in the parcel of land encompassed by Atlantic Avenue to the north, Lingayan Gulf Road to the west, Buildings 1089 and 1098 to the south, and Buildings 763, 770, 759, 768, and 758 to the east.

The topography consists of rolling sand dunes at an elevation ranging from approximately +5 feet to approximately +16 feet NGVD. The site is covered with thick underbrush, briars and trees.

The site is also underlain by several utilities including fiber optics lines, a gas line, a 48-inch storm drainpipe, and a 15-inch storm drainpipe with headwalls.

This geotechnical investigation and report applies only to the project design and location as described. If significant changes develop in the project location or the building designs, then the recommendations and conclusions contained in this report are no longer applicable.

Subsurface Investigation

On 8 January 2002, a preliminary geotechnical investigation was conducted at the proposed project site. Fishburne Drilling, Inc., Chesapeake, Virginia, under the supervision of Norfolk District personnel, drilled one (1) standard penetration test (SPT) boring to a depth of fifty (50) feet. The boring was located at the approximate center of the proposed project site. The purpose of the boring was to determine the subsurface profile beneath the project site to facilitate the conceptual design of the foundation system. Soil samples were visually classified according to the "Unified Soil Classification System."

On 24 May 2002, an additional more intensive soil investigation was performed at the site. Under the supervision of Norfolk District personnel, Fishburne Drilling, Inc. drilled an additional sixteen (16) standard penetration tests (SPT's) to depths ranging from six (6) feet to forty (40) feet. The forty-foot deep borings were located at the corners of the proposed two-story portion of the training building, the twenty-foot deep borings were located at the corners of the remaining portion of the training building, at the center of the unheated storage building, and the east side of the maintenance shop building. And the five-foot deep borings were located throughout the parking and roadway areas. Soil samples were visually classified according to the "Unified Soil Classification System."

Site Geology

The study area is located within the Atlantic Coastal Plain of Southeastern Virginia. The morphology of the Coastal Plain is characterized by its stairstep appearance consisting of wide, gently eastward sloping plains separated by linear, steeper eastward facing scarps. Coastal Plain sediments are soft, commonly unindurated gravels, sands, clays, and marls of Cretaceous through Holocene Age. These deposits strike northeast and dip gently northeast.

Specifically, the site is located in a dynamic barrier beach environmental characterized by features such as berms, scarps, fore dunes, and primary dune ridges. Sediment in the area reflect their depositional environment. Superficial sediments are composed of fine clean sands indicative of nearshore and beach environments. With depth, sediments are encountered that consist of increasing amount of silt, clay and shell fragments that are of deeper marine origin. Geologic formations most probably present are Holocene deposits to elevation –6 MSL, Sandbridge Formation to elevation –29 MSL, and the Norfolk Formation to

elevation –44 MSL where the Yorktown is encountered. These boundary elevations are considered approximate.

Subsurface Conditions

The soil borings indicate the following generalized soil strata underlie the project site:

Stratum A	From ground surface to a depth of 8 feet below ground surface [elevation –1.4 feet MSL]	Loose, moist, tan fine sand with N-Values ranging from 1 to 8 blows per foot.
Stratum B	From below stratum A to a depth of 15 feet below ground surface [elevation –8.4 feet MSL]	Medium compacted, moist, light gray to dark gray fine to medium sand with some gravel. N-Values ranging from 12 to 29 blows per foot.
Stratum C	From below Stratum B to a depth of 50 feet [elevation –43.4 feet MSL]	Dense, fine, moist gray sand with some clay. N-Values ranging from 34 to 75 blows per foot.

Groundwater

Drilling mud was used to advance the drill hole between SPT tests, therefore, a true groundwater reading was not obtained. However, boring logs from previous projects located in the general vicinity of this project indicate groundwater elevations at +6.9 feet to +8.5 feet MSL. Groundwater is expected to fluctuate with time of season, precipitation, etc. For design purposes, assume the groundwater table is at a maximum elevation of +8.5 feet.

Foundation Design

Based on the information derived during the subsurface investigation, shallow foundation systems are recommended for the proposed USARC structures with a maximum bearing pressure of 2000 psf.

The Mason & Hanger Group Inc has indicated that the finished floor elevation of the training center will be 4.0 meters [+13.12 feet] requiring up to 6.4 feet of fill. Prior to filling/grading operations, it is recommended that the building, parking, and roadway areas be proofrolled with a heavy (>10 ton) vibratory roller to compact the loose subgrade soils. Fill material shall be placed in 8-inch uncompacted lifts, compacted to 95% of ASTM D1557, laboratory maximum density. Materials classified by the “Unified Soil Classification System” as GP, GW, GC, GM, SP,

SW, SC and SM in ASTM D2487 are satisfactory as fill material provided less than 20% of the material is smaller than the 100 sieve size. Soils classified as CL, CH, ML, MH, OH, OL, and PT are unsatisfactory insitu and as fill and backfill.

Settlement potential was evaluated using the Schmertmann's Method for settlement of footings over granular soils. Settlement analyses were performed for 2 foot wide wall footings, 3.5 foot wide wall footings, 2 foot x 2 foot isolated footings, and 3.5 foot x 3.5 foot isolated footings, and assumed a maximum bearing pressure of 2000 pounds per square foot (psf). Total settlement was calculated to be less than one (1) inch for all footings analyzed. Because of the cohesionless nature of the foundation soils, the majority of settlement will occur during construction.

Soil boring logs and locations are attached to this report.

Pavement Design

Recommend using a CBR of 20 for subgrade sands compacted to 95% ASTM D1557 maximum density, for design of flexible pavement. Recommend a Modulus of Soil Reaction (K) of 300 pounds per cubic inch (pci) for design of rigid pavement. Since past projects in the Fort Story area have displayed difficulty in maintaining 95 percent compaction of the top 6 inches of subgrade, it is recommended to place a dense aggregate over a geotextile composed of polypropyene having an EOS between 70 and 100.

Utility Design

Based on past experience at Fort Story, the soil and groundwater are considered non-corrosive.

Prepared by:
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U.S. Army Corps of Engineers
Civil Engineer, Geotechnical Sec.
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SECTION 01090

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the sponsoring organization, e.g. ASTM B 564 Nickel Alloy Forgings. However, when the sponsoring organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the organizations whose publications are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the sponsoring organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)

P.O. Box 9094
Farmington Hills, MI 48333-9094
Ph: 248-848-3700
Fax: 248-848-3701
Internet: http://www.aci-int.org
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AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

4301 North Fairfax Dr., Suite 425
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Arlington, VA 22203
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Fax: 703-528-3816
E-mail: ari@ari.org
Internet: www.ari.org
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AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

11 West 42nd St
New York, NY 10036
Ph: 212-642-4900
Fax: 212-398-0023
Internet: www.ansi.org/
Note: Documents beginning with the letter "S" can be ordered from:
Acoustical Society of America
P. O. Box 1020
Sweickley, PA 15143-9998
Ph: 412-741-1979
Fax: 412-741-0609
Internet: asa.aip.org
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AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)

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Landover, MD 20785-2230
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AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

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Columbus, OH 43228-0518
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
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Internet: http://www.ashrae.org
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AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND SANITARY RESEARCH (ASSE)

901 Canterbury, Suite A
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Fax: 440-835-3488
E-mail: asse@ix.netcom.com
Internet: www.asse-plumbing.org
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AMERICAN WATER WORKS ASSOCIATION(AWWA)

6666 West Quincy
Denver, CO 80235
Ph: 800-926-7337 - 303-794-7711
Fax: 303-347-0804
Internet: www.awwa.org
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AMERICAN WELDING SOCIETY (AWS)

550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
Internet: http://www.amweld.org
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AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

P.O. Box 5690
Grandbury, TX 76049-0690
Ph: 817-326-6300
Fax: 817-326-6306
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APA - THE ENGINEERED WOOD ASSOCIATION (APA)

P.O.Box 11700
Tacoma, WA 98411-0700
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Fax: 253-565-7265
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ARCHITECTURAL WOODWORK INSTITUTE (AWI)

1952 Isaac Newton Square West
Reston, VA 20190
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Fax: 703-733-0584
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-- End of Section --

SECTION 01312A

QUALITY CONTROL SYSTEM (QCS)

1.1 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Import/Export of Data

1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01320A, PROJECT SCHEDULE, Section 01330, SUBMITTAL PROCEDURES, and Section 01451A, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request

by the Contractor, the Government can provide QCS on high-density diskettes or CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

1.3 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

Hardware

IBM-compatible PC with 200 MHz Pentium or higher processor

32+ MB RAM

4 GB hard drive disk space for sole use by the QCS system

3 1/2 inch high-density floppy drive

Compact disk (CD) Reader

Color monitor

Laser printer compatible with HP LaserJet III or better, with minimum 4 MB installed memory.

Connection to the Internet, minimum 28 BPS

Software

MS Windows 95 or newer version operating system (MS Windows NT 4.0 or newer is recommended)

Word Processing software compatible with MS Word 97 or newer

Internet browser

The Contractor's computer system shall be protected by virus protection software that is regularly upgraded with all issued manufacturer's updates throughout the life of the contract.

Electronic mail (E-mail) compatible with MS Outlook

1.4 RELATED INFORMATION

1.4.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the Contractor can obtain the current address from the Government. The current address is www.winrms.usace.army.mil. Login is "qcrms" and password is "corps". In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.4.2 Contractor Quality Control(CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government shall be submitted by E-mail with file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer, a data diskette or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM). The QCS database typically shall include current data on the following items:

1.6.1 Administration

1.6.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

1.6.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

1.6.1.3 Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered

starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.6.1.4 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.6.2 Finances

1.6.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.6.2.2 Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment requests with supporting data by E-mail with file attachment(s). If permitted by the Contracting Officer, a data diskette may be used instead of E-mail. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01451A, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a data diskette or CD-ROM reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01451A, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government using E-mail or diskette within 24 hours after the date covered by the report. Use of either mode of submittal shall be coordinated with the Government representative. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.6.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.6.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.6.3.4 Accident/Safety Tracking.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 200.

1.6.3.5 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.6.3.6 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS.

The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.6.4 Submittal Management

The Government will provide the initial submittal register, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.6.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts", or Section 01320A, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01320A PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function. If used, diskettes and CD-ROMs will be submitted in accordance with the following:

1.8.1 File Medium

The Contractor shall submit required data on 3-1/2 inch double-sided

high-density diskettes formatted to hold 1.44 MB of data, capable of running under Microsoft Windows 95 or newer. Alternatively, CD-ROMs may be used. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.8.2 Disk or CD-ROM Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.8.3 File Names

The Government will provide the file names to be used by the Contractor with the QCS software.

1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

-- End of Section --

SECTION 01320L

PROJECT SCHEDULE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referenced in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 1-1-11	(1995) Progress, Schedules, and Network Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Initial Project Schedule; G, RE. Preliminary Project Schedule

Two copies of the schedules showing codes, values, categories, numbers, items, etc., as required.

Qualifications.

Documentation showing qualifications of personnel preparing schedule reports.

SD-05 Design Data

Narrative Report. Schedule Reports.

Two copies of the reports showing numbers, descriptions, dates, float, starts, finishes, durations, sequences, etc., as required.

Periodic Schedule Updates; G, RE.

Two copies of the schedules showing codes, values, categories, numbers, items, etc., as required.

1.3 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel will result in an inability of the Contracting Officer to evaluate Contractor's progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the absence of an approved schedule, the Contracting Officer may withhold approval of requests for progress payments. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

The Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule:

3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods (usually less than 2 percent of all non-procurement activities' Original Durations are greater than 20 days).

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

3.3.2.3 Critical Activities

The following activities shall be listed as separate line activities on the Contractor's project schedule:

a. Submission and approval of mechanical/electrical layout drawings.

b. Submission and approval of O & M manuals.

c. Submission and approval of as-built drawings.

d. Submission and approval of 1354 data and installed equipment lists.

e. Submission and approval of testing and air balance (TAB).

f. Submission of TAB specialist design review report.

g. Submission and approval of fire protection specialist.

h. Submission and approval of testing and balancing of HVAC plus commissioning plans and data.

i. Air and water balance dates.

j. HVAC commissioning dates.

k. Controls testing plan.

l. Controls testing.

m. Performance Verification testing.

n. Other systems testing, if required.

o. Prefinal inspection.

p. Correction of punchlist from prefinal inspection.

q. Final inspection.

3.3.2.4 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.6 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.7 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

3.3.2.8 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.3.2.9 Phase of Work

All activities shall be identified in the project schedule by the phases of

work in which the activity occurs. Activities shall not contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

3.3.2.10 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited, to the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.3.2.11 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to, a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from NTP to the contract completion date.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted in the narrative report at every project schedule update period to assist the Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Program features which calculate one of these parameters from the other shall be disabled.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without all preceding logic being satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case approval of the Contracting Officer. The Contractor shall propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule.

3.3.7 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after the NTP is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after NTP.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after NTP. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail. The Contractor shall participate in a review and evaluation of the proposed network diagrams and analysis by the Contracting Officer. Any revisions necessary as a result of this review shall be resubmitted for approval of the Contracting Officer within ten (10) calendar days after the conference. The approved schedule shall then be the schedule to be used by the Contractor for planning, organizing and directing the work and for reporting progress. If the Contractor thereafter desires to make changes in his method of operating and scheduling he shall notify the Contracting Officer in writing stating the reasons for the change. If the Contracting Officer considers these changes to be of a major nature, he may require the Contractor to revise and submit for approval, without additional cost to the Government, all or the affected portion of the detailed diagrams and mathematical analysis and the summary diagram to show the effect on the entire project. A change may be considered of major nature if the time estimated to be required or actually used for an activity or the logic of sequence of activities is varied from the original plan to a degree that there is a reasonable doubt as to the effect on the contract completion date or dates. Any change in schedule or execution of work which changes the relationship of any activities on the critical path or a near-critical path (path whose float is within 30 days of the float on the critical path) shall be considered a major change. Changes which affect activities with adequate slack time shall be considered as minor changes, except that an accumulation of minor changes may be considered a major change when their cumulative effect might affect the completion date.

3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information

and project schedule data, which in the judgement of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the preliminary submission, initial submission, and every periodic project schedule update throughout the life of the project in addition to the requirements for submission of schedules and reports in paragraph 1.2 "SUBMITTALS".:

3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on the disks shall adhere to the SDEF format specified in ER 1-1-11, Appendix A.

3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, under the MS-DOS Version 5. or 6.x, unless otherwise approved by the Contracting Officer.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Preliminary, Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the MS-DOS version used to format the disk.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with the preliminary, initial, and each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths, a description of current and anticipated problem areas or delaying

factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number on "J-NODE"/"I-NODE" as appropriate.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number. Preceeding and succeeding activities shall include all information listed above in paragraph Schedule Reports. A blank line shall be left between each activity grouping.

3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the NTP until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; and complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity

Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost-to-Date shall be subject to the approval of the Contracting Officer. As a minimum, the Contractor shall address the following items on an activity by activity basis during each progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed .

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations shall be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule which does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the

Contractor is entitled to an extension of time under the provisions of the contract: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any requested time extension of over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until

revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

A document, required of the Contractor, or through the Contractor, from a supplier, installer, manufacturer, or other lower tier Contractor, the purpose of which is to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verifications of quality.

SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

SD-03 Product Data

Preprinted manufacturer material describing a product, system, or material, such as catalog cuts.

SD-04 Samples

Samples, including both fabricated and un-fabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

SD-05 Design Data

Submittals, which provide calculations, descriptions, or documentation regarding the work.

SD-06 Test Reports

Reports of inspections or tests, including analysis and interpretation of test results.

SD-07 Certificates

Statement signed by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the product, system or material meets specified requirements. The statement must be dated after the award of the contract, must state the Contractor's name and address, must name the project and location, and must list the specific

requirements, which are being certified.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material; including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Data, which forms a part of an operation and maintenance manual.

SD-11 Closeout Submittals

All data, documentations, information, and drawings to achieve contract closeout.

All data, documentations, information, and drawings to achieve contract closeout.

SD-13 Records

Documentation to record compliance with technical or administrative requirements.

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Government approval is required for all specification submittal items found in specifications having structural steel connections, extensions of design, Fire Protection/Life Safety, and Commissioning of HVAC, and other items as designated by the Contracting Officer. Government approval (G) is also required for all submittals designated as such in the technical specifications. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings", except for the submittal required for the Quality Control Plan, the Accident Prevention Plan, and the Drug Free Workplace Certification. These submittals which are within the terms of the Contract Clauses entitled "Inspection of Construction", "Accident Prevention", and "Drug Free Workplace respectively". The Government will review all submittals designated as deviating from the Solicitation or Accepted Proposal, as described below.

1.2.2 Information Only

All Contractor submittals not requiring Government approval will be for information only. FIO submittals are identified in the approved submittal register Form 4288. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above. FIO Submittals will be retained at the project site and reviewed prior to Preparatory Meetings in accordance with CEGS-01451, CONTRACTOR QUALITY CONTROL.

1.2.3 Government Approval

All submittals classified for Government Approval (G) are identified in the approved submittal register Form 4288. A code following the "G" designation indicates the approving authority; codes of "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval.

1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the Contractor's Quality Control CQC System Manager

indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER

At the end of Section 00800, SPECIAL CONTRACT REQUIREMENTS, is a submittal register showing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. The Contractor shall maintain a submittal register for the project in accordance with Section 01312 QUALITY CONTROL SYSTEM (QCS). The Government will provide the initial submittal register in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall track all submittals. NOTE: The Contractor is required to add additional entries to the Submittal Register for all items requiring multiple submittals, including Formwork Shop Drawings per Lift, Concrete Reinforcement per Lift, Concrete Lift Drawings per Lift, Multiple Shop Assembly Drawings, etc. These entries should be made prior to original submission of the submittal register within 30 days of Notice to Proceed. The Contractor, QC Manager, and the Contracting Officer's Representative shall meet at the earliest possible date after the award to review and edit the Submittal Register. The edited Submittal Register shall be incorporated into the CQC Plan.

3.3 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 30 calendar days shall be allowed and shown on the register for review and approval of submittals for refrigeration and HVAC control systems.

3.4 ALL SUBMITTALS WHICH EXCEED THE DETAIL SHOWN ON THE CONTRACT DRAWINGS

a. Section 00800, SPECIAL CONTRACT REQUIREMENTS, Paragraph "As-Built Drawings", also require submittal details or drawings which exceed that which is shown on the contract drawings to be transmitted in electronic format. All such submittals must include, along with the hard copy of the drawings required above, CADD files of the submittal in Microstation, for

incorporating into as-built or record drawings.

b. These submittals include those that reflect structural details, foundation layouts, equipment, sizes, mechanical room layouts, and other similar data, including all extensions of design, which were not shown or have changed from the original drawings.

3.5 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached at the end of Section 00800 shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms are included in the QCS software that the Contractor is required to use for this contract. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.6 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

3.6.1 Procedures

The Contractor shall submit directly to the designated reviewing authority ("RE", "ED", "AE") eight (8) copies of all submittals of items requiring shop inspection and six (6) copies of all submittals as called for under the various headings of these specifications. The use of an express mail system shall be used. All submittals (except SD-11 Closeout Submittals) for the project shall be submitted within 63 days after NTP is issued.

3.6.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.7 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.8 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval/accepteance by being so stamped and dated. Three copies of the submittal will be retained by the Contracting Officer and three copies of the submittal will be returned to the Contractor.

3.9 INFORMATION ONLY SUBMITTALS

The Contractor is responsible for preparing and retaining two copies of all FIO submittals in a pair of "Government" files at the Contractor's field office. One copy of the FIO submittals will be used for historical record and transferred to the customer upon completion of the project. The second copy will be used for Quality Assurance reviews, but may be retained at the Government's field office at the discretion of the Quality Assurance Representative. Both files shall be maintained in good order and filed by specification section.

A minimum of 30 days in advance of the Approval Needed By date (Submittal Register, ENG Form 4288, Contractor Schedule Dates, Item "t") the Contractor shall submit only the transmittal form (ENG Form 4025-R) to the Government. The required submittal information shall be complete and available for review at the Contractor's field office. Government personnel will perform discretionary Quality Assurance reviews of the submittals as necessary to satisfy the Government that the Contractor's Quality Control system is providing the specified level of quality. Submittals that contain both Government Approval and Information Only items shall be processed as Government Approved Submittals. Submittals that do not meet the contract requirements will be assigned an "FX" action code by the Contracting Officer, and the submittal deficiencies will be forwarded to the Contractor. The Contractor shall resubmit for Government Approval and in accordance with Paragraph "Disapproved Submittals".

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

3.10 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACATOR (Firm Name)
___ Approved ___ Approved with corrections as noted on submittal data and/or attached sheet(s). SIGNATURE: _____ TITLE: _____ DATE: _____

-- End of Section --

SECTION 01355

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. ARMY (DA)

AR 200-5	Pest Management

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions
40 CFR 68	Chemical Accident Prevention Provisions
40 CFR 152 - 186	Pesticide Programs
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
49 CFR 171 - 178	Hazardous Materials Regulations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps on Engineers Safety and Health Requirements Manual
WETLAND MANUAL	Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Installation Pest Management Coordinator

Installation Pest Management Coordinator (IPMC) is the individual officially designated by the Installation Commander to oversee the Installation Pest Management Program and the Installation Pest Management Plan.

1.2.4 Project Pesticide Coordinator

The Project Pesticide Coordinator (PPC) is an individual that resides at a Civil Works Project office and that is responsible for oversight of pesticide application on Project grounds.

1.2.5 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.6 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.7 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.8 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.9 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.10 Wetlands

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G, RE

The environmental protection plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.7.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.7.2 Contents

The environmental protection plan shall include, but shall not be limited to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1 and the state of Virginia. This plan shall include as a minimum:

1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer and Facility Fire Department in addition to the legally required Federal, State, and local reporting channels

(including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3. Training requirements for Contractor's personnel and methods of accomplishing the training.

4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6. The methods and procedures to be used for expeditious contaminant cleanup.

k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July, and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic meters or tons along with the percent that was diverted.

l. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

m. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

n. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the

air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

o. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

p. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.

q. A pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation Project Office specific requirements. The Contractor shall follow AR 200-5 Pest Management, Chapter 2, Section III "Pest Management Records and Reports" for data required to be reported to the Installation

1.7.3 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination

documents shall be attached,as an appendix, to the Environmental Protection Plan.

1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.9 NOT USED

1.10 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings,plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.11 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings and as specified in Section 01356 STORM WATER POLLUTION PREVENTION MEASURES. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and

outfall protection, diversion channels, and sedimentation basins. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State of Virginia water quality standards and anti-degradation provisions.

3.3.2 Stream Crossings

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments.

3.3.3 Wetlands

The Contractor shall not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from

asphaltic batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State of Virginia rules.

3.4.4 Burning

Burning shall be prohibited on the Government premises.

3.5 NOT USED

3.6 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.6.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

3.6.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 150 mm of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.6.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262 and shall manage and store hazardous waste in accordance with the Installation and hazardous waste management plan. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.6.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site shall be accordance with all Federal, State, and local laws and regulations.

3.6.5 Waste Water

Disposal of waste water shall be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up,

water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

b. For discharge of ground water, the Contractor shall surface discharge in accordance with the requirements of the NPDES or State STORM WATER DISCHARGES FROM CONSTRUCTION SITES permit.

c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing shall be discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator.

3.7 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

3.8 NOT USED

3.9 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.10 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.11 INTEGRATED PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, the Contractor, through the Contracting Officer, shall coordinate with the Installation

Pest Management Coordinator (IPMC) at the earliest possible time prior to pesticide application. The Contractor shall discuss integrated pest management strategies with the IPMC and receive concurrence from the IPMC through the COR prior to the application of any pesticide associated with these specifications. Installation Project Office Pest Management personnel shall be given the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. For termiticide requirements see Section 02364 TERMITICIDE TREATMENT MEASURES FOR SUBTERRANEAN TERMITE CONTROL. The use and management of pesticides are regulated under 40 CFR 152 - 186.

3.11.1 Pesticide Delivery and Storage

Pesticides shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Pesticides shall be stored according to manufacturer's instructions and under lock and key when unattended.

3.11.2 Qualifications

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.11.3 Pesticide Handling Requirements

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS)shall be available for all pesticide products.

3.11.4 Application

Pesticides shall be applied by a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Contracting Officer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

3.12 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.13 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.14 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.15 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.16 NOT USED

3.17 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION 01356A

STORM WATER POLLUTION PREVENTION MEASURES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4439	(1997) Standard Terminology for Geosynthetics
ASTM D 4491	(1996) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996)) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1995) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(1995) Identification, Storage, and Handling of Geosynthetic Rolls

1.2 GENERAL

The Contractor shall implement the storm water pollution prevention measures specified in this section in a manner which will meet the requirements of Section 01355 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit attached to that Section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Mill Certificate or Affidavit

Certificate attesting that the Contractor has met all specified requirements.

1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

1.4.1 Stabilization Practices

The stabilization practices to be implemented may include temporary seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, erosion control matts, protection of trees, preservation of mature vegetation, etc. On his daily CQC Report, the Contractor shall record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, stabilization practices shall be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have permanently ceased.

1.4.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity permanently ceases is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

1.4.1.2 No Activity for Less Than 21 Days

Where construction activity will resume on a portion of the site within 21 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 21 days), then stabilization practices do not have to be initiated on that portion of the site by the fourteenth day after construction activity temporarily ceased.

1.4.2 Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices.

1.4.2.1 Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading).

Silt fences shall be installed in the locations indicated on the drawings. Final removal of silt fence barriers shall be upon approval by the Contracting Officer.

1.4.2.2 Straw Bales

The Contractor shall provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. Bales shall be properly placed to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in a area between a ridge and drain, bales shall be placed as work progresses, bales shall be removed/replaced/relocated as needed for work to progress in the drainage area). Areas where straw bales are to be used are shown on the drawings. Final removal of straw bale barriers shall be upon approval by the Contracting Officer. Rows of bales of straw shall be provided as follows:

a. Along the downhill perimeter edge of all areas disturbed.

b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.

c. Along the toe of all cut slopes and fill slopes of the construction areas.

d. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc. that traverse disturbed areas or carry runoff from disturbed areas. Rows shall be spaced a maximum of 60 meters apart.

e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales. Rows shall be spaced a maximum of 60 m apart.

f. At the entrance to culverts that receive runoff from disturbed areas.

1.4.2.3 Diversion Dikes

Diversion dikes shall have a maximum channel slope of 2 percent and shall be adequately compacted to prevent failure. The minimum height measured from the top of the dike to the bottom of the channel shall be 0.5 m. The minimum base width shall be 1.8 m and the minimum top width shall be 0.6 m. The Contractor shall ensure that the diversion dikes are not damaged by construction operations or traffic. Diversion dikes shall be located as shown on the drawings.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

The geotextile shall comply with the requirements of ASTM D 4439, and

shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of -18 to 49 degrees C. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile	ASTM D 4632	445 N min.
Elongation (%)		30 % max.
Trapezoid Tear	ASTM D 4533	245 N min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 50 mm by 50 mm when oak is used and 100 mm by 100 mm when pine is used, and shall have a minimum length of 1.5 m. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum mass of 1.98 kg per linear meter and a minimum length of 1.5 m.

2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

2.1.4 Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D 4873.

2.2 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, rice, or from grasses such as byhalia, bermuda, etc., furnished in air dry condition. The bales shall have a standard cross section of 350 mm by 450

mm. All bales shall be either wire-bound or string-tied. The Contractor may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 50 mm by 50 mm in cross section and shall have a minimum length of 1 m. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum mass of 1.98 kg per linear meter and a minimum length of 1 m .

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 400 mm above the ground surface and shall not exceed 860 mm above the ground surface. Filter fabric shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 150 mm overlap, and securely sealed. A trench shall be excavated approximately 100 mm wide and 100 mm deep on the upslope side of the location of the silt fence. The 100 mm by 100 mm trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

3.2 INSTALLATION OF STRAW BALES

Straw bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 100 mm. After the bales are staked and chinked (gaps filled by wedging with straw), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 100 mm against the uphill side of the barrier. Loose straw shall be scattered over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 450 mm deep into the ground to securely anchor the bales.

3.3 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

3.3.1 Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with Section 02921 SEEDING, except that the coverage requirements in paragraph ESTABLISHMENT do not apply.

3.3.2 Straw Bale Maintenance

Straw bale barriers shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales. Necessary repairs to barriers or replacement of bales shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the barrier. Bale rows used to retain sediment shall be turned uphill at each end of each row. When a straw bale barrier is no longer required, it shall be removed. The immediate area occupied by the bales and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with Section 02921 SEEDING.

3.3.3 Diversion Dike Maintenance

Diversion dikes shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged diversion dikes and necessary repairs shall be accomplished promptly. When diversion dikes are no longer required, they shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with Section 02921 SEEDING.

3.4 INSPECTIONS

3.4.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 13 mm or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

3.4.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control

measures identified in the Storm Water Pollution Prevention Plan shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

3.4.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

SECTION 01451L

CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

1.2.1 SUBMITTALS

SD-01 Preconstruction Submittals

Quality Control Plan; G, RE

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job

and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 30 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and

control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.3.1 Subcontractor CQC Orientation

Before a Subcontractor begins work on the jobsite, the CQC Manager will train the Subcontractor by showing the video tape entitled "CQC - A Bridge (or Pathway) to Success" and answering any questions pertaining to quality control operations. This requirement is waived only if a Subcontractor attended the initial coordination meeting described above. A copy of this video can be borrowed from the Contracting Officer. A record of the orientation shall be documented in the QC Report.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization.The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, show drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 5 years construction experience on construction similar to this contract or a construction person with a minimum of 10 years in related work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's

absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: electrical, mechanical, structural. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan.

Experience Matrix

	Area	Qualifications
a.	Mechanical	Graduate Mechanical Engineer with 2 yrs experience or person with 5 yrs related experience
b.	Electrical	Graduate Electrical Engineer with 2 yrs related experience or person with 5 yrs related experience
c.	Structural	Graduate Structural Engineer with 2 yrs experience or person with 5 yrs related experience

3.4.4 Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed and passed the course entitled "Construction Quality Management For Contractors". This course is periodically offered by the Associated Builders and Constructors, Inc., or Associated General Contractor, Inc..

3.4.5 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements. When Section 15951 DIRECT DIGITAL CONTROL FOR HVAC and 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS are included in the contract, the submittals required by those sections shall be coordinated with Section 01330 SUBMITTAL PROCEDURES to ensure adequate time is allowed for each type of submittal required.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Resolve all differences.

k. Discussion of the initial control phase.

l. The Government shall be notified at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 48 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract

requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers validated testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $1,375.00 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, f.o.b., at the following address:

For delivery by mail:

Commander and Director
U.S. Army Engineer Waterways Experiment Station
ATTN: CEWES-GS
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the Special Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the

deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of

work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

k. These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

l. Deficiency Tracking System. The Contractor shall maintain a cumulative list of deficiencies identified for the duration of the project. Deficiencies to be listed include those failures, Government oral observations and Notifications of Noncompliance. The list shall be maintained at the project site. Copies of updated listings shall be submitted to the Government at least every 30 days.

3.10 SAMPLE FORMS GENERATED BY RMS SOFTWARE

Sample forms enclosed at the end of this section.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

SECTION 01452A

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S342L	(1993) Load and Resistance Factor Design Specification for Structural Steel Buildings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Special Inspector; G, RE

Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

Quality Assurance Plan; G, RE

A copy of the Quality Assurance Plan covered by a certificate indicating that the plan meets the content specified in this section.

1.3 SPECIAL INSPECTOR

A Special Inspector shall be used to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work

being constructed. Special Inspectors shall perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

1.4 QUALITY ASSURANCE PLAN

A quality assurance plan shall be developed containing the following:

a. A list of all items that require quality assurance Special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on this list.

b. A list of all items that require quality assurance testing, including the type and frequency of testing for each item on this list.

c. The content, distribution, and frequency of special inspection reports.

d. The content, distribution, and frequency of testing reports.

e. The procedures, controls, and people used within the Contractor's organization to develop, sign, and distribute Special Inspection and Testing reports along with the position title and pertinent qualifications of all Contractor personnel involved.

1.5 SPECIAL INSPECTION

The Special Inspection for seismic-resisting system components shall be done as specified. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in this section.

1.5.1 Continuous Special Inspection

Continuous special inspection is the full time observation of the work by the Special Inspector present in the work area whenever work is being performed. Continuous special inspection shall be performed where specified for items as shown on the drawings.

1.5.2 Perodic Special Inspection

Perodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed. The intermittent observation periods shall be at times of significant work, shall be recurrent over the complete work period, and shall total at least 25 percent of the total work time. Perodic special inspection shall be performed where specified for items as shown on the drawings.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PERFORMANCE OF INSPECTIONS

Special Inspections shall be performed for the following where designated on the drawings:

3.1.1 NOT USED

3.1.2 Reinforcing Steel

a. Periodic special inspection during and upon completion of the placement of reinforcing steel in shear walls.

3.1.3 NOT USED

3.1.4 NOT USED

3.1.5 Structural Masonry

a. Periodic special inspection during the preparation of mortar, the laying of masonry units, and placement of reinforcement and prior to placement of grout.

b. Continuous special inspection during grouting, consolidation and reconsolidation and placement of bent-bar anchors.

3.1.6 Structural Steel

a. Periodic special inspection in accordance with AISC S342L for the installation of bolts in trusses located in the assembly hall, except that bolts not required to be fully tensioned need not be inspected for bolt tension, other than to ensure that the plies of the connected elements have been brougt into snug contact

3.1.7 NOT USED

3.1.8 NOT USED

3.1.9 Architectural Components

Special inspection of the architectural components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the components, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for architectural components shall be as follows:

a. Periodic special inspection during the erection and fastening of exterior cladding, interior nonloadbearing partition walls, exterior nonloadbearing walls, and masonry veneer.

b. Periodic special inspection during the anchorage of suspended ceilings.

3.2 NOT USED

3.3 REPORTING AND COMPLIANCE PROCEDURES

a. On the first day of each month, the Contractor shall furnish to the Government five copies of the combined progress reports of the special inspector's observations. These progress reports shall list all special inspections of construction or reviews of testing performed during that month, note all uncorrected deficiencies, and describe the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies . Each monthly report shall be signed by the Contractor.

b. At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. The Contractor shall submit a combined final report containing the signed final reports of all the special inspectors. The Contractor shall sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

-- End of Section --

SECTION 01460L

COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL

Commissioning of the HVAC systems is the responsibility of the General Contractor. The General Contractor shall employ the services of a Commissioning Agent. The Commissioning Agent shall coordinate all aspects of the commissioning process. Commissioning procedures shall conform to National Environmental Balancing Bureau (NEBB) standards, and as listed in this specification.

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Commissioning Agent; G, AE

The Commissioning Agent shall be a NEBB qualified Systems Commissioning Administrator employed by a NEBB certified commissioning firm. The Commissioning Agent's qualifications shall be submitted no later than 30 days after Notice to Proceed.

Commissioning Team

List of team members who will represent the Contractor in the pre-commissioning checks and functional performance testing, at least 2 weeks prior to the start of pre-commissioning checks. Proposed revision to the list, prior to the start of the impacted work.

Test Procedures; G, AE.

Detailed procedures for pre-commissioning checks and functional performance tests shall be submitted no later than 60 days after Notice to Proceed.

Test Schedule; G, AE.

Schedule for pre-commissioning checks and functional performance tests, at least 2 weeks prior to the start of pre-commissioning checks.

SD-06 Test Reports

Test Reports; G, AE.

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

1.2 COMMISSIONING AGENT RESPONSIBILITIES

The Commissioning Agent shall be responsible for the following items, as well as any other items required by NEBB Commissioning Procedures not listed here:

a. Design Review - The Commissioning Agent shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from operating effectively in accordance with the sequence of operation specified. The Commissioning Agent shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation. The report will be submitted to the Contracting Officer no later than 14 days after approval of the Commissioning Agent. The Contracting Officer, the Commissioning Agent, and the Designer shall meet and discuss any items contained in the report no later than 7 days after submission of the report. All items will be resolved at that meeting.

b. Commissioning Plan - The Commissioning Agent shall prepare the Commissioning Plan.

c. Construction - The Commissioning Agent shall review all HVAC system related shop drawings and submittals and verify the submitted equipment complies with the contract requirements. The Commissioning Agent shall review the status of the Pre-Commissioning Checklists, and shall verify the items on the checklists are installed in compliance with the contract requirements. The Commissioning Agent shall perform an onsite review and shall verify that the systems are in compliance with all specifications prior to the Functional Performance Tests.

d. Functional Performance Tests - The Commissioning Agent shall lead the Functional Performance Tests in accordance with the Commissioning Plan.

e. Final Commissioning Report - The Commissioning Agent shall prepare a Final Commissioning Report as required. The report shall detail any deficiencies found during the testing and the corrective actions taken. The report shall include all Pre-Commissioning Checklists and Functional Performance Test Checklists, and any substantiating information.

1.3 SEQUENCING AND SCHEDULING

The Functional Performance Tests described in this Section shall begin only after all work and testing required in related Sections, including Section 15951A DIRECT DIGITAL CONTROL FOR HVAC and Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS, have been successfully completed, and after

all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved.

PART 2 PRODUCTS(NOT APPLICABLE)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND CHECKLISTS

The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein. The team members shall be as follows:

Designation	Function
QA	Contracting Officer's Quality Assurance Representative
QC	Contractor's Quality Control Representative
CA	Commissioning Agent

The following may be required to participate as team members during Pre-Commissioning Checks and Functional Performance Testing at the request of the Commissioning Agent:

Contractor's Mechanical Representative
Contractor's Electrical Representative
Contractor's Testing, Adjusting, and Balancing Representative
Contractor's Controls Representative
Design Agent's Representative
Using Agent's Representative

Each checklist shown in appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2 TESTS

The pre-commissioning checks and functional performance tests shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost

due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

3.2.1 Pre-Commissioning Checks

Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements. Contractor shall make copies of the pre-commissioning checks where there is a large quantity of the particular piece of equipment such that each piece does not have its own sheet.

3.2.2 Functional Performance Tests

Functional performance tests shall be performed for the items indicated on the checklists in Appendix B. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors. Contractor shall make copies of the checklists where there is a large quantity of the particular piece of equipment such that each piece does not have its own sheet. Contractor shall make copies of the performance test where there is a large quantity of the particular piece of equipment such that each piece does not have its own sheet.

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping

For Chilled Water Piping System

Checklist Item	QA	QC	CA
Installation			
a. Piping complete.	___	___	___
b. As-built shop drawings submitted.	___	___	___
c. Piping flushed and cleaned.	___	___	___
d. Strainers cleaned.	___	___	___
e. Valves installed as required.	___	___	___
f. Piping insulated as required.	___	___	___
g. Thermometers and gauges installed as required.	___	___	___
h. Verify operation of valves.	___	___	___
i. Air vents installed as specified.	___	___	___
j. Flexible connectors installed as specified	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Hydrostatic test complete.	___	___	___
b. TAB operation complete.	___	___	___

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping

For Heating Hot Water Piping System

Checklist Item	QA	QC	CA
Installation			
a. Piping complete.	___	___	___
b. As-built shop drawings submitted.	___	___	___
c. Piping flushed and cleaned.	___	___	___
d. Strainers cleaned.	___	___	___
e. Valves installed as required.	___	___	___
f. Piping insulated as required.	___	___	___
g. Thermometers and gauges installed as required.	___	___	___
h. Verify operation of valves.	___	___	___
i. Air vents installed as specified.	___	___	___
j. Flexible connectors installed as specified	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Hydrostatic test complete.	___	___	___
b. TAB operation complete.	___	___	___

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping

For Heating Hot Water (OMS) Piping System

Checklist Item	QA	QC	CA
Installation			
a. Piping complete.	___	___	___
b. As-built shop drawings submitted.	___	___	___
c. Piping flushed and cleaned.	___	___	___
d. Strainers cleaned.	___	___	___
e. Valves installed as required.	___	___	___
f. Piping insulated as required.	___	___	___
g. Thermometers and gauges installed as required.	___	___	___
h. Verify operation of valves.	___	___	___
i. Air vents installed as specified.	___	___	___
j. Flexible connectors installed as specified	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Hydrostatic test complete.	___	___	___
b. TAB operation complete.	___	___	___

Pre-commissioning Checklist - Ductwork

For Air Handler: AHU-1

Checklist Item	QA	QC	CA
Installation			
a. Ductwork complete.	___	___	___
b. As-built shop drawings submitted.	___	___	___
c. Ductwork leak test complete.	___	___	___
d. Fire dampers, smoke dampers, and access doors installed as required.	___	___	___
e. Ductwork insulated as required.	___	___	___
f. Thermometers and gauges installed as required.	___	___	___
g. Verify open/closed status of dampers.	___	___	___
h. Verify smoke dampers operation.	___	___	___
i. Flexible connectors installed as specified	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. TAB operation complete.	___	___	___

Pre-commissioning Checklist - Ductwork

For Air Handler: AHU-2

Checklist Item	QA	QC	CA
Installation			
a. Ductwork complete.	___	___	___
b. As-built shop drawings submitted.	___	___	___
c. Ductwork leak test complete.	___	___	___
d. Fire dampers, smoke dampers, and access doors installed as required.	___	___	___
e. Ductwork insulated as required.	___	___	___
f. Thermometers and gauges installed as required.	___	___	___
g. Verify open/closed status of dampers.	___	___	___
h. Verify smoke dampers operation.	___	___	___
i. Flexible connectors installed as specified	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. TAB operation complete.	___	___	___

Pre-commissioning Checklist - DX Air Cooled Condensing Unit

For Condensing Unit: ACCU-1

Checklist Item	QA	QC	CA
Installation	___	___	___
b. Refrigerant pipe leak tested.	___	___	___
c. Refrigerant pipe evacuated and charged in accordance with manufacturer's instructions.	___	___	___
d. Check condenser fans for proper rotation.	___	___	___
e. Any damage to coil fins has been repaired.	___	___	___
f. Manufacturer's required maintenance/ operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls	___	___	___
Controls			
a. Unit safety/protection devices tested.	___	___	___
b. Control system and interlocks installed.	___	___	___
c. Control system and interlocks operational.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-1A

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-1B

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-2A

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-2B

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-3A

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-3B

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-4A

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-4B

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-1 (OMS)

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: P-2 (OMS)

Checklist Item	QA	QC	CA
Installation			
a. Pumps grouted in place.	___	___	___
b. Pump vibration isolation devices functional.	___	___	___
c. Pump/motor coupling alignment verified.	___	___	___
d. Piping system installed.	___	___	___
e. Piping system pressure tested.	___	___	___
f. Pump not leaking.	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	___
Electrical			
a. Power available to pump disconnect.	___	___	___
b. Pump rotation verified.	___	___	___
c. Control system interlocks functional.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Pressure/temperature gauges installed.	___	___	___
b. Piping system cleaned.	___	___	___
c. Chemical water treatment complete.	___	___	___
d. Water balance complete.	___	___	___
e. Water balance with design maximum flow.	___	___	___
f. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Packaged Air Cooled Chiller

For Chiller: CH-1

Checklist Item	QA	QC	CA
Installation			
a. Chiller properly piped.	___	___	___
b. Chilled water pipe leak tested.	___	___	___
c. Verify that refrigerant used complies with specified requirements.	___	___	___
d. Any damage to coil fins has been repaired.	___	___	___
e. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Separate power is supplied to electric heating tape.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Controls			
a. Factory startup and checkout complete.	___	___	___
b. Chiller safety/protection devices tested.	___	___	___
c. Chilled water flow switch installed.	___	___	___
d. Chilled water flow switch tested.	___	___	___
e. Chilled water pump interlock installed.	___	___	___
f. Chilled water pump interlock tested.	___	___	___

Pre-commissioning Checklist - Hot Water Boiler

For Boiler: GFB-1

Checklist Item	QA	QC	CA
Installation			
a. Boiler intake duct installed.	___	___	___
b. Boiler combustion air intake installed.	___	___	___
c. Boiler hot water piping installed.	___	___	___
d. Boiler hot water piping tested.	___	___	___
e. Boiler makeup water piping installed.	___	___	___
f. Boiler gas piping installed.	___	___	___
g. Boiler gas piping tested.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Boiler system cleaned and filled with treated water.	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___
d. Boiler water treatment system functional.	___	___	___
e. Boiler startup and checkout complete.	___	___	___
f. Combustion efficiency demonstrated.	___	___	___
Electrical			
a. Verify that power disconnect is located within sight of the unit served.	___	___	___
Controls			
a. Hot water pump interlock installed.	___	___	___
b. Hot water pump interlock tested.	___	___	___
c. Hot water heating system balanced.	___	___	___

d. Hot water heating controls operational. ___ ___ ___

Pre-commissioning Checklist - Hot Water Boiler

For Boiler: GFB-2

Checklist Item	QA	QC	CA
Installation			
a. Boiler intake duct installed.	___	___	___
b. Boiler combustion air intake installed.	___	___	___
c. Boiler hot water piping installed.	___	___	___
d. Boiler hot water piping tested.	___	___	___
e. Boiler makeup water piping installed.	___	___	___
f. Boiler gas piping installed.	___	___	___
g. Boiler gas piping tested.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Boiler system cleaned and filled with treated water.	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___
d. Boiler water treatment system functional.	___	___	___
e. Boiler startup and checkout complete.	___	___	___
f. Combustion efficiency demonstrated.	___	___	___
Electrical			
a. Verify that power disconnect is located within sight of the unit served.	___	___	___
Controls			
a. Hot water pump interlock installed.	___	___	___
b. Hot water pump interlock tested.	___	___	___
c. Hot water heating system balanced.	___	___	___

d. Hot water heating controls operational. ___ ___ ___

Pre-commissioning Checklist - Hot Water Boiler

For Boiler: HMB-1 (OMS)

Checklist Item	QA	QC	CA
Installation			
a. Boiler intake duct installed.	___	___	___
b. Boiler combustion air intake installed.	___	___	___
c. Boiler hot water piping installed.	___	___	___
d. Boiler hot water piping tested.	___	___	___
e. Boiler makeup water piping installed.	___	___	___
f. Boiler gas piping installed.	___	___	___
g. Boiler gas piping tested.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Startup			
a. Boiler system cleaned and filled with treated water.	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___
d. Boiler water treatment system functional.	___	___	___
e. Boiler startup and checkout complete.	___	___	___
f. Combustion efficiency demonstrated.	___	___	___
Electrical			
a. Verify that power disconnect is located within sight of the unit served.	___	___	___
Controls			
a. Hot water pump interlock installed.	___	___	___
b. Hot water pump interlock tested.	___	___	___
c. Hot water heating system balanced.	___	___	___

d. Hot water heating controls operational. ___ ___ ___

Pre-commissioning Checklist - Fan Coil Unit

For Fan Coil Unit: FCU-_____

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Access doors/removable panels are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Any damage to coil fins has been repaired.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
a. Chilled water piping properly connected.	___	___	___
b. Chilled water piping pressure tested.	___	___	___
c. Hot water piping properly connected.	___	___	___
d. Hot water piping pressure tested.	___	___	___
Controls			
a. Control valves/actuators properly installed.	___	___	___
b. Control valves/actuators operable.	___	___	___
c. Verify proper location and installation of thermostat.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Construction filters removed and replaced.	___	___	___

b. TAB results +10%/-0% of L/s (cfm) shown on drawings ___ ___ ___

c. TAB Report submitted. ___ ___ ___

Pre-commissioning Checklist - Unit Heater & Cabinet Unit Heater

For Unit Heater: UH-____ CUH-____

Checklist Item	QA	QC	CA
Installation			
a. Hot water piping properly connected.	___	___	___
b. Hot water piping pressure tested.	___	___	___
c. Air vent installed on hot water coil with shutoff valve as specified.	___	___	___
d. Any damage to coil fins has been repaired.	___	___	___
e. Manufacturer's required maintenance/ operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
d. Power available to electric heating coil.	___	___	___
Controls			
a. Control valves properly installed.	___	___	___
b. Control valves operable.	___	___	___
c. Verify proper location and installation of thermostat.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Exhaust Fan

For Exhaust Fan: EF-____ KF-____

Checklist Item	QA	QC	CA
Installation			
a. Fan belt adjusted.	___	___	___
Electrical			
a. Power available to fan disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Controls			
a. Control interlocks properly installed.	___	___	___
b. Control interlocks operable.	___	___	___
c. Dampers/actuators properly installed.	___	___	___
d. Dampers/actuators operable.	___	___	___
e. Verify proper location and installation of thermostat.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. TAB results +10%/-0% to L/s (cfm) shown on drawings	___	___	___
b. TAB Report submitted.	___	___	___

Pre-commissioning Checklist - Split System Air Conditioning Unit

For Computer Room Unit: AC-1

Checklist Item	QA	QC	CA
Installation			
a. Unit properly supported.	___	___	___
b. Access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed and routed to floor drain.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Manufacturer's required maintenance operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
e. Power available to electric heating coil.	___	___	___
Coils/Humidifier			
a. Refrigerant piping properly connected.	___	___	___
b. Refrigerant piping pressure tested.	___	___	___
Controls			
a. Control valves operable.	___	___	___
b. Unit control system operable and verified.	___	___	___
c. Verify proper location and installation of thermostat.	___	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Construction filters removed and replaced.	___	___	___

b. TAB results +10%/-0% L/s (cfm) shown on drawings. ___ ___ ___

c. TAB Report submitted. ___ ___ ___

Pre-commissioning Checklist - Thru the Wall Air Conditioning Unit (OMS)

For Computer Room Unit: PTAC-1

Checklist Item	QA	QC	CA
Installation			
a. Unit properly supported.	___	___	___
b. Access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed and routed to floor drain.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Manufacturer's required maintenance operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
e. Power available to heating coil.	___	___	___
Coils/Humidifier			
a. Refrigerant piping properly connected.	___	___	___
b. Refrigerant piping pressure tested.	___	___	___
Controls			
a. Control valves operable.	___	___	___
b. Unit control system operable and verified.	___	___	___

c. Verify proper location and installation of thermostat. ___ ___ ___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced. ___ ___ ___

b. TAB results +10%/-0% L/s (cfm) shown on drawings. ___ ___ ___

c. TAB Report submitted. ___ ___ __

Pre-commissioning Checklist - Thru the Wall Air Conditioning Unit (OMS)

For Computer Room Unit: PTAC-2

Checklist Item	QA	QC	CA
Installation			
a. Unit properly supported.	___	___	___
b. Access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed and routed to floor drain.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Manufacturer's required maintenance operational clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Proper motor rotation verified.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
e. Power available to heat coils.	___	___	___
Coils/Humidifier			
a. Refrigerant piping properly connected.	___	___	___
b. Refrigerant piping pressure tested.	___	___	___

Controls

a. Control valves operable. ___ ___ ___

b. Unit control system operable and verified. ___ ___ ___

c. Verify proper location and installation of thermostat. ___ ___ ___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced. ___ ___ ___

b. TAB results +10%/-0% L/s (cfm) shown on drawings. ___ ___ ___

c. TAB Report submitted. ___ ___ ____

Pre-commissioning Checklist - HVAC System Controls

For HVAC System:

Checklist Item	QA	QC	CA
Installation			
a. As-built shop drawings submitted.	___	___	___
b. Layout of control panel matches drawings.	___	___	___
c. Framed instructions mounted in or near control panel.	___	___	___
d. Components properly labeled (on inside and outside of panel).	___	___	___
e. Control components piped and/or wired to each labeled terminal strip.	___	___	___
f. EMCS connection made to each labeled terminal strip as shown.	___	___	___
g. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	___
h. Shielded wiring used on electronic sensors.	___	___	___
i. Air dryer installed as specified.	___	___	___
j. Water drain installed as specified.	___	___	___
Main Power and Control Air			
a. 110 volt AC power available to panel.	___	___	___
b. 138 kPa gauge (20 psig) 20 psig compressed air available to panel.	___	___	___

Testing, Commissioning, and Balancing

a. Testing, Commissioning, and Balancing Report submitted. ___ ___ ___

Pre-commissioning Checklist - Single Zone Air Handling Unit

For Air Handling Unit: AHU-1

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Any damage to coil fins has been repaired.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Coils			
a. Chilled water piping properly connected.	___	___	___
b. Chilled water piping pressure tested.	___	___	___
c. Hot water piping properly connected.	___	___	___
d. Hot water piping pressure tested.	___	___	___
e. Air vents installed on water coils as specified.	___	___	___
f. Any damage to coil fins has been repaired.	___	___	___
Controls			
a. Control valves/actuators properly installed.	___	___	___

b. Control valves/actuators operable. ___ ___ ___

c. Dampers/actuators properly installed. ___ ___ ___

d. Dampers/actuators operable. ___ ___ ___

e. Verify proper location and installation of thermostat. ____ ___ ___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced. ___ ___ ___

b. TAB results +10%/-0% L/s (cfm) shown on drawings. ___ ___ ___

c. TAB Report submitted. ___ ___ ___

Pre-commissioning Checklist - Single Zone Air Handling Unit

For Air Handling Unit: AHU-2

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Condensate drainage is unobstructed.	___	___	___
f. Fan belt adjusted.	___	___	___
g. Any damage to coil fins has been repaired.	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Coils			
a. Chilled water piping properly connected.	___	___	___
b. Chilled water piping pressure tested.	___	___	___
c. Hot water piping properly connected.	___	___	___
d. Hot water piping pressure tested.	___	___	___
e. Air vents installed on water coils as specified.	___	___	___
f. Any damage to coil fins has been repaired.	___	___	___
Controls			
a. Control valves/actuators properly installed.	___	___	___

b. Control valves/actuators operable. ___ ___ ___

c. Dampers/actuators properly installed. ___ ___ ___

d. Dampers/actuators operable. ___ ___ ___

e. Verify proper location and installation of thermostat. ____ ___ ___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced. ___ ___ ___

b. TAB results +10%/-0% L/s (cfm) shown on drawings. ___ ___ ___

c. TAB Report submitted. ___ ___ ___

Pre-commissioning Checklist - Heating Ventilating Unit

For Air Handling Unit: HV-1 (OMS)

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Fan belt adjusted.	___	___	___
f. Combustion air intake/fire exhaust installed thru the roof.	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Heat Exchanger			
a. Gas piping properly connected.	___	___	___
b. Gas piping pressure tested.	___	___	___
c. Any damage to heat exchanger has been repaired.	___	___	___
Controls			
a. Dampers/actuators properly installed.	___	___	___
b. Dampers/actuators operable.	___	___	___
c. Verify proper location and installation of thermostat.	____	___	___
Testing, Adjusting, and Balancing (TAB)			
a. Construction filters removed and replaced.	___	___	___

b. TAB results +10%/-0% L/s (cfm) shown on drawings. ___ ___ ___

c. TAB Report submitted. ___ ___ ___

Pre-commissioning Checklist - Kitchen Make-Up Air Handling Unit

For Air Handling Unit: KMUA-1

Checklist Item	QA	QC	CA
Installation			
a. Vibration isolation devices installed.	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	___
c. Casing undamaged.	___	___	___
d. Insulation undamaged.	___	___	___
e. Fan belt adjusted.	___	___	___
f. Combustion air intake/fire exhaust installed thru the roof.	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	___
h. Combustion air intake installed.	___	___	___
i. Flue exhaust installed.	___	___	___
Electrical			
a. Power available to unit disconnect.	___	___	___
b. Power available to unit control panel.	___	___	___
c. Proper motor rotation verified.	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___
Heat Exchanger			
a. Gas piping properly connected.	___	___	___
b. Gas piping pressure tested.	___	___	___
c. Any damage to heat exchanger has been repaired.	___	___	___
Controls			
a. Dampers/actuators properly installed.	___	___	___
b. Dampers/actuators operable.	___	___	___
c. Verify proper location and installation of thermostat.	____	___	___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced. ___ ___ ___

b. TAB results +10%/-0% L/s (cfm) shown on drawings. ___ ___ ___

c. TAB Report submitted. ___ ___ ___

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: AHU-1 ____ AHU-2 ____

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply fan operating:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper at minimum position. _____

(4) Chilled water control valve modulating to maintain space cooling temperature set point. _____

(5) Hot water control valve modulating to maintain space heating temperature set point input from outside air temperature controller. _____

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Chilled water control valve modulating to maintain space cooling temperature set point. _____

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the supply fan off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify cooling coil and heating coil operation by varying thermostat set point from cooling set point to heating set point and returning to cooling set point. _____

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Pumps

For Pump: P-1A ____ P-1B ____ P-2A ____ P-2B ____ P-3A ____ P-3B ____
P-4A ____ P-4B ____ P-1 (OMS) ____ P-2 (OMS) ____

Prior to performing this checklist, ensure that for closed loop systems, system is pressurized and the make-up water system is operational or, for open loop systems, that the sumps are filled to the proper level.

1. Activate pump start using control system commands (all possible combination, on/auto, etc.). ON_____ AUTO_____ OFF_____

a. Verify pressure drop across strainer:

Strainer inlet pressure _____ kPa (_____ psig)
Strainer outlet pressure _____ kPa (_____ psig)

Strainer inlet pressure _____ psig
Strainer outlet pressure _____ psig

b. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, pump design conditions, and pump manufacturer's performance.

	DESIGN	TAB	ACTUAL
Pump inlet pressure (kPa gauge)	_____	_____	_____
Pump outlet pressure (kPa gauge)	_____	_____	_____

	DESIGN	TAB	ACTUAL
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (kPa gauge)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (L/s)	_____	_____

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

d. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (kPa gauge)	_____	_____

Pump outlet pressure	_____	_____
Pump flow rate (L/s)	_____	_____

SHUTOFF 100 percent

Pump inlet pressure (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (gpm)	_____	_____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage		_____	_____
Voltage		_____	
Voltage to ground	_____	_____	_____

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage		_____	_____
Voltage		_____	
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

_____

_____

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Heating Ventilating Unit

For Air Handling Unit: HV-1

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply fan operating:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation -

(1) Outside air damper is open. _____

(2) Exhaust Fans EF-2 and EF-3 in OMS are on _____

(3) Dampers on Louvers LV-6 and LV-7 are open _____

c. Unoccupied mode of operation

(1) Outside air damper is closed. _____

(2) Exhaust Fans EF-2 and EF-3 are off. _____

(3) Dampers on Louvers LV-6 & LV-7 are closed. _____

(4) Verify low limit space temperature is maintained as specified in sequence of operation. _____

d. The following shall be verified when the supply fan off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

e. Verify heat exchanger operation by varying thermostat set point. _____

(1) Verify temperature delta T is met _____

f. Verify safety shut down initiated by smoke detectors. _____

g. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional

performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____
Commissioning Agent	_____

Functional Performance Test Checklist - Kitchen Make-Up Air Unit

For Air Handling Unit: KMUA-1

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply fan operating:

(1) All dampers in normal position. _____

(2) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation -

(1) Outside air damper is open. _____

(2) KEF-1 is on _____

c. Unoccupied mode of operation

(1) Outside air damper is closed. _____

(2) KEF-1 is off. _____

(3) Verify low limit space temperature is maintained as specified in sequence of operation. _____

d. The following shall be verified when the supply fan off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

e. Verify heat exchanger operation by varying thermostat set point. _____

(1) Verify temperature delta T is met _____

f. Verify safety shut down initiated by smoke detectors. _____

g. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative
_____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Packaged Air Cooled Chiller

For Chiller: CH-1

1. Functional Performance Test: Contractor shall demonstrate operation of chilled water system as per specifications including the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows.

a. Start chilled water pump and establish chilled water flow. Verify chiller-chilled water proof-of-flow switch operation. _____

b. Verify control system energizes chiller start sequence. _____

c. Verify chiller senses chilled water temperature above set point and control system activates chiller start. _____

d. Verify functioning of "soft start" sequence. _____

e. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____

f. Restart air handling equipment one minute after chiller shut down. Verify chiller restart sequence. _____

2. Verify chiller inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, chiller design conditions, and chiller manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Chiller inlet pressure (kPa gauge)	_____	_____	_____
Chiller inlet pressure (psig)	_____	_____	_____
Chiller outlet pressure (kPa gauge)	_____	_____	_____
Chiller outlet pressure (psig)	_____	_____	_____

3. Verify chiller amperage each phase and voltage phase-to-phase and phase-to-ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	
Voltage	_____		
Voltage to ground	_____	_____	_____

4. Record the following information:

Ambient dry bulb temperature _____ degrees C
Ambient wet bulb temperature _____ degrees C
Entering chilled water temperature _____ degrees C
Leaving chilled water temperature _____ degrees C

Ambient dry bulb temperature _____ degrees F
Ambient wet bulb temperature _____ degrees F
Entering chilled water temperature _____ degrees F
Leaving chilled water temperature _____ degrees F

5. Unusual vibration, noise, etc.

_____

_____

6. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative
_____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Unit: ACCU-1

1. Functional Performance Test: Contractor shall demonstrate operation of refrigeration system as per specifications including the following: Start building air handler to provide load for condensing unit. Activate controls system start sequence as follows.

a. Start air handling unit. Verify control system energizes condensing unit start sequence. _____

b. Shut off air handling equipment (AC-1) to verify condensing unit de-energizes. _____

c. Restart air handling equipment (AC-1) one minute after condensing unit shut down. Verify condensing unit restart sequence.
_____

2. Verify condensing unit amperage each phase and voltage phase to phase

and phase to ground.

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	
Voltage	_____		
Voltage to ground	_____	_____	_____

3. Record the following information:

Ambient dry bulb temperature _____ degrees C
Ambient wet bulb temperature _____ degrees C
Suction pressure _____ kPa gauge
Discharge pressure _____ kPa gauge

Ambient dry bulb temperature _____ degrees F
Ambient wet bulb temperature _____ degrees F
Suction pressure _____ psig
Discharge pressure _____ psig

4. Unusual vibration, noise, etc.

_____

_____

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative Representative _____

Contractor's Testing, Adjusting and Balancing _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Hot Water Boiler

For Boiler: GFB-1 ____ GFB-2 ____ HWB-1 (OMS) ____

1. Functional Performance Test: Contractor shall demonstrate operation of hot water system as per specifications including the following: Start

building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.

a. Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation. _____

b. Verify control system energizes boiler start sequence. _____

c. Verify boiler senses hot water temperature below set point and control system activates boiler start. _____

d. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Boiler inlet pressure (kPa gauge)	_____	_____	_____
Boiler outlet pressure (kPa gauge)	_____	_____	_____
Boiler flow rate (L/s)	_____	_____	_____
Flue-gas temperature at boiler outlet		_____	_____
Percent carbon dioxide in flue-gas		_____	_____
Draft at boiler flue-gas exit		_____	_____
Draft or pressure in furnace		_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

	DESIGN	TAB	ACTUAL
Boiler inlet pressure (psig)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Boiler flow rate (gpm)	_____	_____	_____
Flue-gas temperature at boiler outlet		_____	_____
Percent carbon dioxide in flue-gas		_____	_____
Draft at boiler flue-gas exit		_____	_____
Draft or pressure in furnace		_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

3. Record the following information:

Ambient temperature _____ degrees C
Entering hot water temperature _____ degrees C
Leaving hot water temperature _____ degrees C

Ambient temperature _____ degrees F
Entering hot water temperature _____ degrees F

Leaving hot water temperature _____ degrees F

4. Verify temperatures in item 3 are in accordance with the reset schedule. _____

5. Verify proper operation of boiler safeties. _____

6. Unusual vibration, noise, etc.

_____

_____

7. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement. _____

8. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Fan Coil Units FCU-____

The Contracting Officer will select fan coil units to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall demonstrate operation of selected fan coils as per specifications including the following:

a. Cooling/heating fan coils:

(1) Verify fan coil unit response to room temperature set point adjustment. Changes to be cooling set point to heating set point and return to cooling set point. _____

(2) Check blower fan air flow. _____ L/s
Check blower fan air flow. _____ cfm

(3) Check cooling coil water flow. _____ L/s
Check cooling coil water flow. _____ cfm

(4) Verify proper operation of cooling water control valve. _____

(5) Check cooling mode inlet air temperature. _____ degrees C
Check cooling mode inlet air temperature. _____ degrees F

(6) Check cooling mode outlet air temperature. _____ degrees C
Check cooling mode outlet air temperature. _____ degrees F

(7) Check heating coil water flow. _____ L/s
Check heating coil water flow. _____ gpm

(8) Verify proper operation of heating water control valve. _____

(9) Check heating mode inlet air temperature. _____ degrees C
Check heating mode inlet air temperature. _____ degrees F

(10) Check heating mode outlet air temperature. _____ degrees C
Check heating mode outlet air temperature. _____ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative
_____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Unit Heaters

The Contracting Officer will select unit heaters to be spot-checked during the functional performance test. The number of terminals shall not exceed 10.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters as per specifications including the following:

a. Verify unit heater response to room temperature set point adjustment. Changes to be heating set point to heating set point minus 10 degrees and return to heating set point. _____

b. Check blower fan speed. _____rpm

c. Check heating mode inlet air temperature. _____ degrees C Check heating mode inlet air temperature. _____ degrees F

d. Check heating mode outlet air temperature. _____ degrees C Check heating mode outlet air temperature. _____ degrees F

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - Split System Air Conditioning Unit

For Computer Room Unit: AC-1

1. Functional Performance Test: Contractor shall verify operation of computer room unit as per specification including the following:

a. System safeties allow start if safety conditions are met. _____

b. Verify cooling and heating operation by varying thermostat set point from space set point to space set point plus 10 degrees, space set point minus 10 degrees, and returning to space set point. _____

c. Verify that airflow is within +10/-0 percent of design airflow.

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

Functional Performance Test Checklist - HVAC Controls

For HVAC System: _____

The Contracting Officer will select HVAC control systems to undergo functional performance testing. The number of systems shall not exceed 10.

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the following tests:

a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, sling psychrometer, inclined manometer, etc.

b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings.

Sensor _____
Manual measurement _____
Panel reading value _____

c. Verify system stability by changing the controller set point as follows:

(1) Air temperature - 10 degrees F

(2) Water temperature - 10 degrees F

(3) Static pressure - 10 percent of set point

(4) Relative humidity - percent (RH)

The control system shall be observed for 10 minutes after the change in set point. Instability or excessive hunting will be unacceptable.

d. Verify interlock with other HVAC controls.

e. Verify interlock with fire alarm control panel.

f. Verify interlock with EMCS.

2. Verify that operation of control system conforms to that specified in the sequence of operation.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Quality Control Representative	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Contractor's Officer's Representative	_____
Using Agency's Representative	_____
Commissioning Agent	_____

-- End of Section --

SECTION 01800

EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 General Requirements

The Contractor shall provide 6 complete copies of the Equipment Operating, Maintenance, and Repair Manuals. Separate manuals shall be provided for each utility system as defined hereinafter. Operations and Maintenance manuals shall be submitted and approved before field training or 90 days before substantial completion (whichever occurs earlier), and as specified in Special Contract Requirement 10. An amount of $20,000 shall be withheld until submittal and approval of O&M manuals is complete.

1.2.1 Definitions

1.2.2 Equipment

A single piece of equipment operating alone or in conjunction with other equipment to accomplish a system function.

1.2.3 System

A combination of one or more pieces of equipment which function together to accomplish an intended purpose (i.e. HVAC system is composed of many individual pieces of equipment such as fans, motors, compressors, valves, sensors, relays, etc.)

1.2.4 Hard Cover Binders

The manuals shall be hard cover with posts, or 3-ring binders, so sheets may be substituted easily. The following identification shall be printed on the cover: the words "EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS," the project name, building number, and an indication of utility or systems covered, the name of the Contractor, and the Contract number. Manuals shall be approximately 8-1/2 by 11-inches with large sheets folded in and capable of being easily pulled out for reference. All manuals for the project must be similar in appearance, and be of professional quality.

1.2.5 Warning Page

A warning page shall be provided to warn of potential dangers (if they exist, such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, high pressures, etc.). The warning page shall be placed inside the front cover and in front of the title page. Also, any

necessary Material Safety Data Sheets (MDSD) shall be included here.

1.2.6 Title Page

The title page shall include the same information shown on the cover and show the name of the preparing firm and the date of publication.

1.2.7 Table of Contents

Each volume of the set of manuals for this project shall include a table of contents, for the entire set, broken down by volume.

PART 2 PRODUCTS (Not Used.)

PART 3 EXECUTION

3.1 GENERAL

Manuals shall be organized according to the following format, and will include information for each item of equipment (NOTE: This includes any equipment which may have been omitted from the items listed in Paragraph 3.2, System/Equipment Requirements.) A draft outline and table of contents shall be submitted for approval at 50% contract completion.

TABLE OF CONTENTS

PART I. Introduction.

(a) Equipment Description.
(b) Functional Description.
(c) Installation Description.

PART II. Operating Principles.

PART III. Safety.

PART IV. Preventive Maintenance

(a) Preventive Maintenance Checklist. Lubrication
(b) Charts and Diagrams.

PART V. Spare Parts Lists

(a) Troubleshooting Guide
(b) Adjustments
(c) Common Repairs and Parts Replacement

PART VI. Illustrations

3.1.1 Part I-Introduction

Part I shall provide an introduction, equipment or system description,

functional description and theory of operation, and installation instructions for each piece of equipment. Complete instructions for uncrating, assembly, connection to the power source and pre-operating lubrication shall be included in the installation instructions as applicable. Illustrations, including wiring and cabling diagrams, are required as appropriate in this section. Halftone pictures of the equipment should be included in the introduction and equipment description, as well as system layout drawings with each item of equipment located and marked. Copies of previously submitted shop drawings shall not be used in these manuals.

3.1.2 Part II-Operating Principles

Part II shall provide complete instructions for operating the system, and each piece of equipment. Illustrations, halftone pictures, tables, charts, procedures, and diagrams are required when applicable. This will include step-by-step procedures for start-up and shutdown of both the system and each component piece of equipments, as well as adjustments required to obtain optimum equipment performance, and corrective actions for malfunctions. Performance sheets and graphs showing capacity data, efficiencies, electrical characteristics, pressure drops, and flow rates shall be shown here, also. Marked-up catalogs or catalog pages do not satisfy this requirements. Performance information shall be presented as concisely as possible and contain only data pertaining to equipment actually installed. Actual test data collected for Contractor performance shall be included here.

3.1.3 Part III-Safety

Part III shall contain the general and specific safety requirements peculiar to each item of equipment. Safety information should be repeated as notes cautions, and warnings in other sections where appropriate to operations described.

3.1.4 Part IV-Preventive Maintenance

Part IV shall contain a troubleshooting guide, including detailed instructions for all common adjustments and alignment procedures, including a detailed maintenance schedule. Also, include a diagnostic chart showing symptoms and solutions to problems. Include test hookups to determine the cause, special tools and test equipment, and methods for returning the equipment to operating conditions. Information may be in chart form or in tabular format with appropriate headings. Instructions shall be included for the removal, disassembly, repair, reassembly, and replacement of parts and assemblies where applicable and the task is not obvious.

3.1.5 Part V-Spare Parts List

Part V shall contain a tabulation of description data and parts location illustrations for all mechanical and electrical parts. The heading of the parts list shall clearly identify the supplier, purchase order number, and equipment. The unit price for each part shall be included, also. Parts shall be listed by major assemblies, and the listing shall be arranged in columnar form. Also, names and addresses of the nearest manufacturer's

representatives will be included, as well as any special warranty information. A list of spare parts that are recommended to be kept in stock by the Government installation shall be provided.

3.1.6 Part VI-Illustrations

Part VI shall contain assembly drawings for the complete equipment or system and for all major components. Complete wiring diagrams and schematics shall be included. Other illustrations, such as exploded views, block diagrams, and cutaway drawings, are required as appropriate.

3.1.7 Framed Instructions

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, including equipment, ductwork, piping valves, dampers, and control sequence, shall be posted at a location near the equipment described. Condensed operating instructions explaining preventive maintenance procedures methods of checking the system for normal safe operation, valve schedule and procedures for safely starting and stopping the system shall be prepared in type form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting. The framed instructions shall be posted before field training.

3.1.8 Field Training

Contractor shall conduct a training course for the operating staff for each particular system. The training period, a total of 8 hours of normal working time, shall start after the system is functionally completed. The field instructions shall cover all of the items contained in the Equipment Operating, Maintenance and Repair Manuals. The training will include both classroom and "hands-on" training. The Contractor shall submit a lesson plan outlining the information to be discussed during training periods. This lesson plan will be submitted 90 days before contract completion and approved before the field training occurs. Training shall be digitally videotaped on CD and shall be furnished to the Government within ten (10) days following training. Training shall be documented by the Contractor and a list of attendees shall be furnished to the Government.

3.1.9 SYSTEM/EQUIPMENT REQUIREMENTS

3.1.10 Facility Heating System

Information shall be provided on the following equipment: boilers, water treatment, chemical feed pumps and tanks, converters, heat exchangers, pumps, unit heaters, fin-tube radiation, air handling units (both heating only and heating and cooling), and valves (associated with heating systems).

3.1.11 Air-Conditioning Systems

Provide information in chillers, packaged air-conditioning equipment, towers, water treatment, chemical feed pumps and tanks, air-cooled condensers, pumps, compressors, air handling units, and valves (associated with air-conditioning

systems).

3.1.12 Temperature Control and HVAC Distribution Systems

Provide all information described for the following equipment: valves, fans, air handling units, pumps, boilers, converters and heat exchangers, chillers, water cooled condensers, cooling towers, and fin-tube radiation, control air compressors, control components (sensors, controllers, adapters and actuators), and flow measuring equipment.

3.1.13 NOT USED

3.1.14 NOT USED

3.1.15 Exterior Electrical Systems

Information shall be provided on the following equipment: power transformers, relays, reclosers, breakers, and capacitor bank controls.

3.1.16 Interior Electrical Systems

Information shall be provided on the following equipment: relays, motor control centers, switchgear, solid state circuit breakers, motor controller, EPS lighting systems, wiring diagrams and troubleshooting flow chart on control systems, and special grounding systems.

3.1.17 Energy Monitoring and Control Systems

The maintenance manual shall include descriptions of maintenance for all equipment, including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

3.1.18 Domestic Water Systems

The identified information shall be provided on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentation, laboratory test equipment, chemical feeders, valves, switching gear, and automatic controls.

3.1.19 NOT USED

3.1.20 Fire Protection Systems

Information shall be provided on the following equipment: alarm valves, manual valves, regulators, foam and gas storage tanks, piping materials, sprinkler heads, nozzles, pumps, and pump drivers.

3.1.21 Fire Detection Systems

The maintenance manual shall include description of maintenance for all equipment, including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

3.1.22 Plumbing Systems

Information shall be provided on the following equipment: water heaters, valves, pressure regulators backflow preventors, piping materials, and plumbing fixtures.

3.1.23 NOT USED

3.1.24 Cathodic Protection Systems

Information shall be provided on the following material and equipment: rectifiers, meters, anodes, anode backfill, anode lead wire, insulation material and wire size, automatic controls (if any), rheostats, switches, fuses and circuit breakers, type and size of rectifying elements, type of oil in oil-immersed rectifiers, and rating of shunts.

3.1.25 Generator Installations

Information shall be provided on the following equipment: generator sets, automatic transfer panels, governors, exciters, regulators starting systems, switchgear, and protective devices.

3.1.26 Miscellaneous Systems

Information shall be provided on the following: communication and ADP systems, security and intrusion alarm, elevators, material handling, active solar, photovoltaic, nurse call, paging, intercom, closed circuit TV, irrigation, sound and material delivery systems, kitchen, refrigeration, disposal, icemaking equipment, and other similar type special systems not otherwise specified.

3.2 PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY

The Contractor shall promptly furnish and shall cause any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures and equipment furnished and/or installed by the Contractor or sub-contractor, except prices do not need to be provided for Government-Furnished Property. This information shall be listed in the RMS CQC Module furnished by the Government. See example forms at the end of the Special Contractor Requirements.

-- End of Section --

SECTION 02220L

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan; G, RE

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.4 Protection From the Weather

The interior of buildings to remain; salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Protection of Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 1.8 m (6 foot) high fence. The fence shall be securely erected a minimum of 1.5 m from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.6 Environmental Protection

The work shall comply with the requirements of Section 01355 ENVIRONMENTAL PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed to 0.9 meters below grade. Interior walls, other than retaining walls and partitions, shall be removed to 0.9 meters below grade or to top of concrete slab on ground. Basement slabs shall be broken up to permit drainage. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in Section 08000. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section 02300 EARTHWORK.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 NOT USED

3.4.1.3 NOT USED

3.4.1.4 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off site in an approved landfill. Combustible material shall be disposed of off the site.

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.6 REMOVAL OF PCB TRANSFORMER

3.6.1 Removal and Transportation of PCB's

The Contractor shall furnish all labor, materials, and equipment necessary to remove and transport PCB contaminated transformer(s) and other associated materials to the DPW for disposal. The Contractor shall be responsible for testing the transformer(s) for PCB's.

All transportation will be in accordance with 40 CFR 761, as amended, Polychlorinated Biphenyls (PCB) Manufacturing, Processing, Distribution in Commerce and Use of Prohibitions.

3.6.2 Description of Transformer(s)

A description of each transformer is to include ID number, Manufacturer, Voltage Rating, gallons of dielectric fluid, weight, serial number, cubic feet, and PPM/PCB concentration shall be provided by the Contractor after

the tests for PCB's are completed.

3.6.3 Containment of PCB

If necessary, the Contractor will use leak proof secondary containment pans with a minimum of 12-inch sides when transporting the PCB item to the DPW.

3.6.4 PCB Manifest

A manifest of all PCB items/materials transported to the DPW shall be kept by the Contractor. The manifest should consist of a description of the items being disposed of as required in Paragraph 3.6.2.

3.6.5 Spillage of PCB's

The Contractor is responsible for his actions resulting in the spillage of PCB's. Responsibilities include immediate containment, cleanup and disposal as well as sampling and analysis of spill area to ensure no residual contamination remains. Disposal shall consist of transporting spillage to the DPW in sealed drums marked as to content.

3.7 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and to the limits and depths indicated on the drawings.

-- End of Section --

SECTION 02230A

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 mm in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials Other Than Salable Timber

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 40 mm or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 40 mm in diameter shall be painted with an

approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 455 mm below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 DISPOSAL OF MATERIALS

3.4.1 NOT USED

3.4.2 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --

SECTION 02300A

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457 mm (18-in) Drop
AASHTO T 224	(1996) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1140	(1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods

	(Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 NOT USED

1.3 NOT USED

1.4 DEFINITIONS

1.4.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, and less than 20% of the material is smaller than the 0.150 mm (No. 100) sieve size. Satisfactory materials for grading shall be comprised of stones less than 200 mm , except for fill material for pavements and railroads which shall be comprised of stones less than 75 mm in any dimension.

1.4.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.4.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 9.0 mm sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 9.0 mm sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse

material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

1.4.5 NOT USED

1.4.6 Topsoil

Material suitable for topsoils obtained from offsite areas or excavations and meeting the requirements of Section 244.02(b) of the Virginia DOT Road and Bridge Specifications.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Earthwork; G, RE.

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material.

Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing; G, RE.

Within 24 hours of conclusion of physical tests, 4 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

1.6 SUBSURFACE DATA

Subsurface soil boring logs are shown on the drawings. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined with prior notice at offices of the Norfolk District Corps of Engineers. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.7 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.8 BLASTING

Blasting will not be permitted.

1.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 100 millimeters. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material

not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 1 meter from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.3 SELECTION OF BORROW MATERIAL

Borrow areas and excess fill material are not available on Fort Story. The Contractor is required to obtain off site borrow areas and haul material on to Fort Story. Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 NOT USED

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02630 STORM-DRAINAGE SYSTEM; and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by steel-wheeled rollers, vibratory compactors, or other approved equipment. Vibratory compactors shall weigh a minimum of 9.07 metric tons (10 tons).

3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

3.7.1 General Requirements

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 200 mm; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction shall be accomplished by steel-wheeled rollers, vibratory compactors, or other approved equipment. Vibratory compactors shall weigh a minimum of 9.07 metric tons (10 tons). The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

3.7.2 Frozen Material

Embankment shall not be placed on a foundation which contains frozen material, or which has been subjected to freeze-thaw action. This prohibition encompasses all foundation types, including the natural ground, all prepared subgrades (whether in an excavation or on an embankment) and all layers of previously placed and compacted earth fill which become the foundations for successive layers of earth fill. All material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, winter shutdowns, or earthwork operations, shall be removed to a depth that is acceptable to the Contracting Officer and replaced with new material. Alternatively, the material will be

thawed, dried, reworked, and recompacted to the specified criteria before additional material is placed. The Contracting Officer will determine when placement of fill shall cease due to cold weather. The Contracting Officer may elect to use average daily air temperatures, and/or physical observation of the soils for his determination. Embankment material shall not contain frozen clumps of soil, snow, or ice.

3.8 EMBANKMENTS

3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm. The material shall be placed in successive horizontal layers of loose material not more than 200 millimeters in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by steel-wheeled rollers, vibratory compactors, or other approved equipment. Vibratory compactors shall weigh more than 9.07 metric tons (10 tons).

3.9 SUBGRADE PREPARATION

3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 150 mm below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified.

3.9.2 Compaction

Compaction shall be accomplished by steel-wheeled rollers, vibratory compactors, or other approved equipment. Vibratory compactors shall weigh more than 9.07 metric tons (10 tons). Except for paved areas and railroads, each layer of the embankment shall be compacted to at least 95 percent of laboratory maximum density.

3.9.2.1 NOT USED

3.9.2.2 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, the top 200 mm of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

3.9.2.3 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 95 percentage laboratory maximum density for the full depth of the shoulder.

3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.11 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 30 mm of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

3.12 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 50 mm depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 100 mm and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

3.13 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to

establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, and ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements. Tests on recompacted areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.13.1 Fill and Backfill Material Gradation

One test per 500 cubic meters stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136 or ASTM D 422.

3.13.2 In-Place Densities

a. One test per 250 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 75 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

a. One check test per lift for each 1000 square meters, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 300 square meters, of fill or backfill areas compacted by hand-operated machines.

3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per

day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

-- End of Section --

SECTION 02315A

EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEGREE OF COMPACTION

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, abbreviated as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Testing; G, RE

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC provided that less than 20% of the material is smaller than the 0.150 mm (No. 100) sieve size.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 75 mm. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic.

2.2 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 37.5 mm and no more than 2 percent by weight shall pass the 4.75 mm sieve.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

Clearing and grubbing is specified in Section 02230 CLEARING AND GRUBBING.

3.2 TOPSOIL

Topsoil shall be stripped to a depth of 100 millimeters below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be disposed as specified for excess excavated material.

3.3 EXCAVATION

The existing ground to a point 1.5 m beyond the building footprint shall be over-excavated to elevation 1.500 meters, which represents 1.52 m (5 foot) below bottom of footing elevation. The existing subgrade to a depth of 200 mm shall be compacted to 95% maximum density per ASTM D 1557 with a minimum 9.07 metric ton (10 ton) vibratory steel smooth-drum roller. Satisfactory fill material shall be provided in the over-excavated area in maximum 0.200 m base thickness lifts and compacted to 95% of maximum density per ASTM D 1557. The over-excavated material may be reused as fill material provided it meets the requirements of paragraph 2.1.1 Satisfactory Materials.

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified, and shall include trenching for utility and foundation drainage systems to a point 1.5 m beyond the building line of each building and structure, excavation for outside grease interceptors and all work incidental thereof. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material; and payment will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced, at no additional cost to the Government, with satisfactory materials to the indicated excavation grade; except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.4 DRAINAGE AND DEWATERING

3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.4.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 900 mm of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 0.9 meters below the working level.

3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered.

3.7 BLASTING

Blasting will not be permitted.

3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 150 mm below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted in conformance with paragraph FILLING AND BACKFILLING.

3.9 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained as specified in Section 02300 EARTHWORK.

3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and

all unsatisfactory material shall be disposed of as specified in Section 02300 EARTHWORK. Borrow material is not available at Fort Story. The Contractor is required to purchase from off-site sources and haul onto Fort Story satisfactory borrow material.

3.11 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 150 mm before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 200 mm, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 300 mm and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by vibratory steel-wheeled rollers. Vibratory compactors shall weigh more than 9.07 metric tons (10 tons). Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

3.13 FILLING AND BACKFILLING

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 200 mm in loose thickness, or 150 mm when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 600 mm above sewer lines and 300 mm above other utility lines shall be free from stones larger than 25 mm in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height

of backfill above the top of footing; the area remaining shall be compacted in layers not more than 100 mm in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
Fill, embankment, and backfill		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recompaction over underground utilities and heating lines shall be by hand tamping.

3.14 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937 shall be used only for soft, fine-grained, cohesive soils. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

3.14.1 In-Place Densities

In-place density and moisture content test results shall be included with the Contractor's daily construction quality control reports.

3.14.1.1 In-Place Density of Subgrades

One test per 250 square meters or fraction thereof.

3.14.1.2 In-Place Density of Fills and Backfills

One test per 250 square meters or fraction thereof of each lift for fill or backfill areas compacted by other than hand or hand-operated machines. The density for each lift of fill or backfill materials for trenches, pits, building perimeters or other structures or areas less than 1.2 meters in width, which are compacted with hand or hand-operated machines shall be tested as follows: One test per each area less than 150 square meters, or one test for each 30 linear meter of long narrow fills 50 meters or more in length.

3.14.2 Moisture Content

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216.

3.14.3 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material, including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 750 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density will be made.

3.15 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16 GRADING

Areas within 1.5 m outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 SPREADING TOPSOIL

Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder

planting or maintenance operations. The subgrade shall be pulverized to a depth of 50 mm by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 1.46 kN/m to 2.34 kN/m of roller. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

3.18 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

SECTION 02316A

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 NOT USED

1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Field Density Tests; G, RE
Testing of Backfill Materials; G, RE

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, provided that less than 20% of the material will pass the 0.150 mm (No. 100) sieve size.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 75 mm. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic meter or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic meter in volume, except that pavements shall not be considered as rock.

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 75 millimeters in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a 0.075 mm mesh sieve and no less than 95 percent by weight passing the 25 mm sieve. The maximum allowable aggregate size shall be 37.5 millimeters, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 37.5 millimeters or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 17 millimeters in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 152 mm (6 inches) wide with minimum thickness of 0.102 mm (0.004 inch). Tape shall have a minimum strength of 12.1 MPa (1750 psi) lengthwise and 10.3 MPa (1500 psi) crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 1 meter deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

2.3 Detection Wire For Non-Metalic Piping

Detection wire shall be insulated single strand, solid copper with a minimum diameter of 12 AWG.

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 600 mm. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 1.2 meters high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 2 meters high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm (24 inches) plus pipe outside diameter (O.D.) for pipes of less than 600 mm (24 inches) inside diameter and shall not exceed 900 mm (36 inches) plus pipe outside diameter for sizes larger than 600 mm (24 inches) inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 50 millimeters or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 100 millimeters below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.2 Stockpiles

Stockpiles of satisfactory shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm loose thickness for compaction by hand operated machine compactors, and 200 mm loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils

and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 0.6 meters above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

3.2.1.3 Bedding and Initial Backfill

Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 02300 EARTHWORK control. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and

compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution

Virginia Natural Gas will install all distribution and service piping, meters, and regulators at no cost to the project.

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 0.9 meters from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 300 millimeters of cover is required.

3.3.3 NOT USED

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 600 mm from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 450 millimeters below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer.

3.4.2 Testing of Backfill Materials

Classification of backfill materials shall be determined in accordance with ASTM D 2487 and the moisture-density relations of soils shall be determined in accordance with ASTM D 1557. A minimum of one soil classification and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 30 meters of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic meters of material used. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 0.6 meters above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 900 mm (36 inches) shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

-- End of Section --

SECTION 02364A

TERMITICIDE TREATMENT MEASURES FOR SUBTERRANEAN TERMITE CONTROL

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Termiticide Application Plan; G, RE

Termiticide application plan with proposed sequence of treatment work with dates and times. The termiticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area/volume treated, amount applied; and the name and state license number of the state certified applicator shall be included.

Termiticides; G, RE

Manufacturer's label and Material Safety Data Sheet (MSDS) for termiticides proposed for use.

Foundation Exterior

Written verification that other site work will not disturb the treatment.

Utilities and Vents

Written verification that utilities, vents have been located.

Crawl and Plenum Air Spaces

Written verification that crawl spaces and plenum air spaces have been located.

Application Equipment

A listing of equipment to be used.

SD-04 Samples

Termiticides

Termiticide samples obtained during application, upon request.

SD-06 Test Reports

Equipment Calibration and Tank Measurement

Certification of calibration tests conducted on the equipment used in the termiticide application.

Soil Moisture

Soil moisture test result.

SD-07 Certificates

Qualifications

Qualifications and state license number of the termiticide applicator.

1.2 QUALIFICATIONS

The Contractor's principal business shall be pest control. The Contractor shall be licensed and the termiticide applicators certified in the state where the work is to be performed. Termiticide applicators shall also be certified in the U.S. Environmental Protection Agency (EPA) pesticide applicator category which includes structural pest control.

1.3 SAFETY REQUIREMENTS

The Contractor shall formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Use the clothing and personal protective equipment specified on the labeling for use during all phases of the application.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Termiticide material shall be delivered to the site in the original unopened containers bearing legible labels indicating the EPA registration number and manufacturer's registered uses. All other materials to be used on site for the purpose of termite control shall be delivered in new or otherwise good condition as supplied by the manufacturer or formulator.

1.4.2 Storage

Materials shall be stored in designated areas and in accordance with manufacturer's labels. Termiticides and related materials shall be kept under lock and key when unattended.

1.4.3 Handling

Termiticides shall be handled in accordance with manufacturer's labels. Manufacturer's warnings and precautions shall be observed. Materials shall be handled preventing contamination by dirt, water, and organic material. Protect termiticides from sunlight as recommended by the manufacturer.

1.5 INSPECTION

Termiticides shall be inspected upon arrival at the job site for conformity to type and quality in accordance with paragraph TERMITICIDE. Each label shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Other materials shall be inspected for conformance with specified requirements. Unacceptable materials shall be removed from the job site.

1.6 WARRANTY

The Contractor shall provide a 3-year written warranty against infestations or reinfestations by subterranean termites of the buildings or building additions constructed under this contract. Warranty shall include annual inspections of the buildings or building additions.

PART 2 PRODUCTS

2.1 TERMITICIDES

Termiticides shall be currently registered by the EPA. Termiticide shall be selected for maximum effectiveness and duration after application. The selected termiticide shall be suitable for the soil and climatic conditions at the project site.

PART 3 EXECUTION

3.1 TECHNICAL REPRESENTATIVE

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for subterranean termites. They may be present during treatment application.

3.2 SITE PREPARATION

Site preparation shall be in accordance with Sections 02230 CLEARING AND GRUBBING, 02300 EARTHWORK, 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS, 02921 SEEDING, 02922 SODDING, and 02930 EXTERIOR PLANTING. Work related to final grades, landscape plantings, foundations, or any other alterations to finished construction which might alter the condition of treated soils, shall be coordinated with this specification.

3.2.1 Ground Preparation

Food sources shall be eliminated by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form

boards, and scrap lumber from the site, before termiticide application begins.

3.2.2 Verification

Before work starts, the Contractor shall verify that final grades are as indicated and smooth grading has been completed in accordance with Section 02300 EARTHWORK. Soil particles shall be finely graded with particles no larger than 25 mm and compacted to eliminate soil movement to the greatest degree.

3.2.3 Foundation Exterior

The Contractor shall provide written verification that final grading and landscape planting operations will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

3.2.4 Utilities and Vents

The Contractor shall provide written verification that the location and identity of HVAC ducts and vents, water and sewer lines, and plumbing have been accomplished prior to the termiticide application.

3.2.5 Crawl and Plenum Air Spaces

The Contractor shall provide written verification that the location and identity of crawl and plenum air spaces have been accomplished prior to the termiticide application.

3.3 SITE CONDITIONS

The following conditions shall determine the time of application.

3.3.1 Soil Moisture

Soils to be treated shall be tested immediately before application. Soil moisture content shall be tested to a minimum depth of 75 mm . The soil moisture shall be as recommended by the termiticide manufacturer. The termiticide will not be applied when soil moisture exceeds manufacturer's recommendations because termiticides do not adhere to the soil particles in saturated soils.

3.3.2 Runoff and Wind Drift

Termiticide shall not be applied during or immediately following heavy rains. Applications shall not be performed when conditions may cause runoff or create an environmental hazard. Applications shall not be performed when average wind speed exceeds 16 km per hour. The termiticide shall not be allowed to enter water systems, aquifers, or endanger humans or animals.

3.3.2.1 Vapor Barriers and Waterproof Membranes

Termiticide shall be applied prior to placement of a vapor barrier or

waterproof membrane.

3.3.2.2 Utilities and Vents

Prior to application, HVAC ducts and vents located in treatment area shall be turned off and blocked to protect people and animals from termiticide.

3.3.3 Placement of Concrete

Concrete covering treated soils shall be placed as soon as the termiticide has reached maximum penetration into the soil. Time for maximum penetration shall be as recommended by the manufacturer.

3.4 TERMITICIDE TREATMENT

3.4.1 Equipment Calibration and Tank Measurement

Immediately prior to commencement of termiticide application, calibration tests shall be conducted on the application equipment to be used and the application tank shall be measured to determine the volume and contents. These tests shall confirm that the application equipment is operating within the manufacturer's specifications and will meet the specified requirements. The Contractor shall provide written certification of the equipment calibration test results within 1 week of testing.

3.4.2 Mixing and Application

Formulating, mixing, and application shall be performed in the presence of the Contracting Officer or the technical representative. A closed system is recommended as it prevents the termiticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying termiticides shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.4.3 Treatment Method

For areas to be treated, the Contractor shall establish complete and unbroken vertical and/or horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Application shall not be made to areas which serve as crawl spaces or for use as a plenum air space.

3.4.3.1 Surface Application

Surface application shall be used for establishing horizontal barriers. Surface applicants shall be applied as a coarse spray and provide uniform distribution over the soil surface. Termiticide shall penetrate a minimum of 25 mm into the soil, or as recommended by the manufacturer.

3.4.3.2 Rodding and Trenching

Rodding and trenching shall be used for establishing vertical soil barriers. Trenching shall be to the depth of the foundation footing. Width of trench shall be as recommended by the manufacturer, or as indicated. Rodding or other approved method may be implemented for saturating the base of the trench with termiticide. Immediately after termiticide has reached maximum penetration as recommended by the manufacturer, backfilling of the trench shall commence. Backfilling shall be in 150 mm rises or layers. Each rise shall be treated with termiticide.

3.4.4 Sampling

The Contracting Officer may draw from stocks at the job site, at any time and without prior notice, samples of the termiticides used to determine if the amount of active ingredient specified on the label is being applied.

3.5 VERIFICATION OF MEASUREMENT

Once termiticide application has been completed, tank contents shall be measured to determine the remaining volume. The total volume measurement of used contents for the application shall equal the established application rate for the project site conditions. The Contractor shall provide written verification of the measurements.

3.6 CLEAN UP, DISPOSAL, AND PROTECTION

Once application has been completed, the Contractor shall proceed with clean up and protection of the site without delay.

3.6.1 Clean Up

The site shall be cleaned of all material associated with the treatment measures, according to label instructions, and as indicated. Excess and waste material shall be removed and disposed off site.

3.6.2 Disposal of Termiticide

The Contractor shall dispose of residual termiticides and containers off Government property, and in accordance with label instructions and EPA criteria.

3.6.3 Protection of Treated Area

Immediately after the application, the area shall be protected from other use by erecting barricades and providing signage as required or directed. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE. Signage shall be placed inside the entrances to crawl spaces and shall identify the space as treated with termiticide and not safe for children and animals.

3.7 CONDITIONS FOR SATISFACTORY TREATMENT

3.7.1 Equipment Calibrations and Measurements

Where results from the equipment calibration and tank measurements tests

are unsatisfactory, re-treatment will be required.

3.7.2 Testing

Should an analysis, performed by a third party, indicate that the samples of the applied termiticide contain less than the amount of active ingredient specified on the label, and/or if soils are treated to a depth less than specified or approved, re-treatment will be required.

3.7.3 Disturbance of Treated Soils

Soil and fill material disturbed after treatment shall be re-treated before placement of slabs or other covering structures.

3.7.4 Termites Found Within the Warranty Period

If live subterranean termite infestation or termite damage is discovered during the warranty period, the Contractor shall re-treat the site.

3.8 RE-TREATMENT

Where re-treatment is required, the Contractor shall:

a. Re-treat the soil and/or perform other treatment as necessary for prevention or elimination of subterranean termite infestation.

b. Repair damage caused by termite infestation.

-- End of Section --

SECTION 02373

GEOTEXTILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4354	(1999) Sampling of Geosynthetics for Testing
ASTM D 4355	(1999) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1997) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999a) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(1988; R 1996) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(2000) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(2001) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.2 NOT USED

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Thread

A minimum of 7 days prior to scheduled use, proposed thread type for sewn seams along with data sheets showing the physical properties of the thread.

Manufacturing Quality Control Manual Sampling and Testing

A minimum of 7 days prior to scheduled use, manufacturer's quality control manual.

SD-07 Certificates

Geotextile; G, RE

A minimum of 7 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.5.1 Delivery

The Contracting Officer shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.5.2 Storage

Rolls of geotextile shall be protected from construction equipment, chemicals, sparks and flames, temperatures in excess of 71 degrees C , or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.5.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

Geotextile shall be a woven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material may also be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	N	700	ASTM D 4632
SEAM STRENGTH	N	100	ASTM D 4632
PUNCTURE	N	250	ASTM D 4833
TRAPEZOID TEAR	N	250	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE	70-100	ASTM D 4751
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

2.1.2 Thread

Sewn seams shall be constructed with high-strength polyester, nylon, or

other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer shall be responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

The Contractor shall provide assistance to the Contracting Officer in the collection of quality assurance samples. Samples shall be collected upon delivery to the site for quality assurance testing at the request of the Contracting Officer. Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. The outer layer of the geotextile roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 1 meter long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

The Contractor shall provide quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test method ASTM D 4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 02300 EARTHWORK.

3.2.2 Placement

The Contractor shall notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

3.3.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 300 mm at all longitudinal and transverse joints. Where seams must be oriented across the slope, the upper panel shall be lapped over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.3.2 Sewn Seams

Factory and field seams shall be continuously sewn on all slopes steeper than 1 vertical on 4 horizontal. The stitch type used shall be a 401 locking chain stitch or as recommended by the manufacturer. Quality Assurance seam samples shall be provided to the Government at the request of the Contracting Officer. Seam strength shall meet the minimum requirements specified in Table 1. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 450 mm of overlap.

3.4 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.5 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 300 mm beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed by methods recommended by the geotextile manufacturer.

3.7 COVERING

Geotextile shall not be covered prior to inspection and approval by the Contracting Officer. Cover soil shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 1 m. No equipment shall be operated directly on top of the geotextile without approval of the Contracting Officer. Equipment with ground pressures less than 50 kPa shall be used to place the first lift over the geotextile. A minimum of 300 mm of soil shall be maintained between full-scale construction equipment and the geotextile. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 2.2 m/s.

-- End of Section --

SECTION 02510A

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997ael) Carbon Structural Steel
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(1994; Errata Nov 1996) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm) and 54 In. through 64 In. (1,400 mm through 1,600 mm) for Water Service
AWWA C200	(1997) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C502	(1994; C502a) Dry-Barrel Fire Hydrants

AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C509	(1994; Addendum 1995) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C702	(1992) Cold-Water Meters - Compound Type
AWWA C706	(1996) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C707	(1982; R 1992) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1997; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA C905	(1997) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA Work Practices	(1988) Recommended Work Practices for A/C Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS

INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

NSF INTERNATIONAL (NSF)

NSF 14	(1998) Plastics Piping Components and Related Materials
NSF 61	(1999) Drinking Water System Components - Health Effects (Sections 1-9)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 1.5 m outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines less than 80 mm (3 inches) in diameter shall be polyvinyl chloride (PVC) plastic, or copper tubing, unless otherwise shown or specified. Piping for water service lines 80 mm (3 inches) and larger shall be ductile iron, polyvinyl chloride (PVC) plastic, unless otherwise shown or specified.

1.2.2 Distribution Lines 80 mm (3 Inches) or Larger

Piping for water distribution lines 80 mm (3 inches) or larger shall be

ductile iron, polyvinyl chloride (PVC) through 900 mm (36 inch) nominal diameter plastic, unless otherwise shown or specified.

1.2.3 NOT USED

1.2.4 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 1.5 m line.

1.2.5 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.6 Plastic Piping System

Plastic piping system components (PVC, polyethylene, thermosetting resin and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF 14 and be legibly marked with their symbol.

1.2.7 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 NOT USED

1.4 NOT USED

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation

The manufacturer's recommendations for each material or procedure to be utilized.

Waste Water Disposal Method; G, RE.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-06 Test Reports

Bacteriological Disinfection; G, RE.

Test results from commercial laboratory verifying disinfection.

SD-07 Certificates

Installation

A statement signed by the manufacturer's field representative certifying that the Contractor's personnel are capable of properly installing the pipe on the project.

Meters

Manufacturer's certificate stating that each meter furnished has been tested for accuracy of registration and compliance with the accuracy and capacity requirements of the appropriate AWWA standard.

1.6 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.6.1 NOT USED

1.6.2 Polyethylene (PE) Pipe Fittings and Accessories

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901.

1.6.3 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 NOT USED

2.1.2 Plastic Pipe

2.1.2.1 NOT USED

2.1.2.2 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 100 mm (4 inch) Diameter:

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 1.03 MPa (150 psi) working pressure, 1.38 MPa (200 psi) hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 1.03 MPa (150 psi) working pressure, 1.38 MPa (200 psi) hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure MPa	Minimum Hydrostatic Pressure MPa
26	0.689	0.917
21	0.827	1.103
17	1.034	1.379
13.5	1.379	1.834

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the

requirements of 1.03 MPa (150 psi) working pressure and 1.38 MPa (200 psi) hydrostatic test pressure.

b. Pipe 100 through 300 mm Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

c. Pipe 350 through 900 mm Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 1.03 MPa (150 psi), unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be coated in accordance with Section 13110 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE). Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

2.1.6 NOT USED

2.1.7 Copper Tubing

Copper tubing shall conform to ASTM B 88M , Type K, annealed.

2.2 FITTINGS AND SPECIALS

2.2.1 NOT USED

2.2.2 PVC Pipe System

a. For pipe less than 100 mm (4 inch) diameter, fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings; fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467; and fittings for elastomeric-gasket joint pipe shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.

b. For pipe 100 mm (4 inch) diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 1.03 MPa (150 psi) pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with

AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.2.3 NOT USED

2.2.4 Ductile-Iron Pipe System

Fittings and specials shall be suitable for 1.03 MPa (150 psi) pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

2.2.5 NOT USED

2.2.6 Copper Tubing System

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 NOT USED

2.3.2 Plastic Pipe Jointing

2.3.2.1 NOT USED

2.3.2.2 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

2.3.2.3 PVCO Pipe

Joints shall conform to ASTM D 3139. Elastomeric gaskets shall conform to ASTM F 477.

2.3.3 NOT USED

2.3.4 NOT USED

2.3.5 Ductile-Iron Pipe Jointing

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricants shall conform to the applicable

requirements of AWWA C111.

2.3.6 NOT USED

2.3.7 NOT USED

2.3.8 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.3.9 Copper Tubing Jointing

Joints shall be compression-pattern flared and shall be made with the specified fittings.

2.4 VALVES

2.4.1 Check Valves

Check valves shall be designed for a minimum working pressure of 1.03 MPa (150 psi) or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 50 mm (2 inches) and larger shall be outside lever and spring type.

a. Valves 50 mm (2 inches) and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

b. Valves larger than 50 mm (2 inches) shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the Class 125 type conforming to ASME B16.1.

2.4.2 Gate Valves

Gate valves shall be designed for a working pressure of not less than 1.03 MPa (150 psi). Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 80 mm (3 inches) shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 80 mm (3 inches) and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient-Seated Gate Valves: For valves 80 to 300 mm (3 to 12 inches) in size, resilient-seated gate valves shall conform to AWWA C509.

2.4.3 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 80 through 250 mm in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.4.4 NOT USED

2.4.5 NOT USED

2.4.6 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which shall be attached to each post.

2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 5 mm. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over

the pipe at the valve location.

2.6 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 21 MPa in accordance with Section 03300CAST-IN-PLACE STRUCTURAL CONCRETE.

2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA C502 with valve opening at least 125 mm (5 inches) in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 200 mm above the ground grade. Hydrants shall have a 150 mm (6 inch) bell connection, two 65 mm (2-1/2 inch) hose connections and one 115 mm (4-1/2 inch) pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design, material, and workmanship shall be equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with 1 coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and 2 finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the installation's standard colors or as directed by the Contracting Officer. Suitable bronze adapter for the115 mm (4-1/2 inch) outlet, with caps, shall be furnished.

2.8 NOT USED

2.9 MISCELLANEOUS ITEMS

2.9.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.9.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.9.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88M , Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.9.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 1.375 MPa (200 psi).

2.9.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 1.03 MPa. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 67.8 Newton meters (50 foot-pound).

2.9.6 NOT USED

2.9.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.9.8 Meters

Meters shall be the type and size shown on the drawings or specified. Meters of each of the various types furnished and installed shall be supplied by one manufacturer.

2.9.8.1 NOT USED

2.9.8.2 Turbine Type

Turbine type meters shall conform to AWWA C701 Class I. The main casing shall be bronze or cast iron protected by corrosion resistant coating with stainless steel external fasteners. Registers shall be straight-reading type, shall be open and shall read in cubic meters. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

2.9.8.3 Compound Type

Compound type meters shall conform to AWWA C702 and shall be furnished with strainers. The main casing shall be bronze or cast iron protected by corrosion resistant coating with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be open and shall read in cubic meters. The meter shall not be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C702.

2.9.9 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall be concrete with cast iron lid and cast iron meter reader lid. Plastic boxes and lids shall be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 3 m from a sewer except where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 1.8 m from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 3 m each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 900 mm horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 600

mm above the sewer main. Joints in the sewer main, closer horizontally than 900 mm to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 300 mm shall be maintained between pipes.

3.1.2.5 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be steel, manufactured in accordance with AWWA C200, ASTM A 36/A 36M, as specified for storm drains in Section 02630 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 50 mm between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding or suitable pipe support shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with corrosion protection as required in Section 13110 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

3.1.2.6 Structures

Where water pipe is required to be installed within 1 m of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 NOT USED

3.1.3.2 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.3.3 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special

bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 NOT USED

3.1.4.2 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.3 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA Work Practices.

3.1.4.4 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.5 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 NOT USED

3.1.5.2 NOT USED

3.1.5.3 PVC Plastic Pipe Requirements

a. Pipe less than 100 mm (4 inch) diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 100 through 300 mm diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 100 mm (4 inch) diameter with configuration using elastomeric ring gasket.

c. Pipe 350 through 900 mm diameter: Joints shall be elastomeric gasket push-on joints made in accordance with AWWA M23.

3.1.5.4 NOT USED

3.1.5.5 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.6 NOT USED

3.1.5.7 NOT USED

3.1.5.8 Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.9 NOT USED

3.1.5.10 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 3 mm thickness of coal tar over all fitting surfaces.

3.1.5.11 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 1.5 m outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 1.5 m from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 50 mm (2 Inches) and Smaller

Service lines 50 mm (2 inches) and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in TABLE I. Where 2 or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size mm	Corporation Stops, mm For Ductile-Iron Pipe	Outlets w/Service Clamps, mm Single & Double Strap
80	--	25
100	25	25
150	32	40
200	40	50
250	40	50

TABLE I. SIZE OF CORPORATION STOPS AND OUTLET

Pipe Size mm	Corporation Stops, mm For Ductile-Iron Pipe	Outlets w/Service Clamps, mm Single & Double Strap
300 & larger	50	50

NOTE:

a. Service lines 40 mm (1-1/2 inches) and smaller shall have a service stop.

b. Service lines 50 mm (2 inches) in size shall have a gate valve.

3.1.6.2 Service Lines Larger than 50 mm (2 Inches)

Service lines larger than 50 mm (2 inches) shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 80 mm (3 inches) and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.6.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 NOT USED

3.1.8 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.8.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 150 mm (6 inch) branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 450 mm above the finished surrounding grade, and the operating nut not more than 1.2 m above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 450 mm above the finished surrounding grade, the top of the hydrant not more than 600 mm above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 100 mm thick and 400 mm square. Not less than 2 cubic meters of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.8.2 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.8.3 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 1.2 m on all sides of the box, or the undisturbed trench face if less than 1.2 m.

3.1.8.4 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.9 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 100 mm (4 inches) in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.10.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 1.38 MPa pressure. Water supply lines designated on the drawings

shall be subjected to a pressure equal to 1.38 MPa. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 34.5 kPa (5 psi) of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 0.5 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 BACTERIAL DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. From several points in the unit, personnel from the Contractor's commercial laboratory

shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 02513

BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T-27	(1984) Sieve Analysis of Fine and Coarse Aggregate
AASHTO T-30	(1984) Mechanical Analysis of Extracted Aggregate
AASHTO T-164	(1986) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
AASHTO T-168	(1986)R Sampling Bituminous Paving Mixtures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C-127	(1984) Specific Gravity and Absorption of Coarse Aggregate
ASTM C-128	(1984) Specific Gravity and Absorption of Fine Aggregate
ASTM E-548	(1984) Standard Practice for Preparation of Criteria for use in the Evaluation of Testing Laboratories and Inspection Bodies

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT	Standard Specifications for Road and Bridge Construction

1.3 GENERAL

All work and materials shall conform to the applicable requirements of Section 200 through Section 700 of the Virginia Department of Transportation (VDOT) Specifications except as noted in these

specifications, construction plans or contract documents. In case of difference between VDOT Specifications and the CONTRACT CLAUSES and SPECIAL CONTRACT REQUIREMENTS of this Solicitation, the CONTRACT CLAUSES and SPECIAL CONTRACT REQUIREMENTS shall govern.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Job Mix Formula (JMF); G, RE. Aggregrates; G, RE.
Bituminous Material; G, RE.

The job mix formula, at least 14 days before it is to be used. Notification on the selection of aggregate source Notification on the selection of bituminous materials source.

Bituminous Material

Certified copies of the bituminous material manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

SD-06 Test Reports

Test

Certified copies of aggregate test results, not less than 30 days before the material is required in the work.

1.5 ABBREVIATIONS AND DEFINITIONS

Standard abbreviations shall be in accordance with Section 101.01 of the VDOT Specifications. Where such terms as "Chairman," "Commission," "Engineer," or "Department" are used, they shall mean "Contracting Officer's Representative." Whenever the words "Extra Work" or similar phrase is used, it shall mean "Changes" as defined in the CONTRACT CLAUSES.

1.6 CONTROL OF MATERIALS

Control of materials shall be in accordance with Section 106 of VDOT Specifications in addition to the requirements of the CONTRACT CLAUSES.

1.7 MEASUREMENT AND PAYMENT

Measurement and payment will be made part of the Lump Sum Payment for the project.

1.8 SURFACING

1.8.1 General

Surfacing shall be in accordance with the plans and per the applicable sections of the VDOT Specifications, except quality control testing.

1.8.2 JOB-MIX FORMULA

The Contractor shall submit to the Contracting Officer for approval five copies of the bituminous concrete job-mix formulas. The job-mix formulas shall be based on Section 406 of the VDOT Specifications for Mix Type SM-9.0A and IM19.0A.

1.9 QUALITY CONTROL

1.9.1 LABORATORY

The Contractor shall furnish onsite laboratory facilities sufficiently staffed and equipped to perform the testing specified. As an alternative, the Contractor may procure the services of an industry recognized laboratory. If the Contractor elects to furnish a laboratory facility, the exact location on the project site shall be subject to the approval of the Contracting Officer.

1.9.2 CAPABILITY CHECK OF CONTRACTOR-FURNISHED FIELD LABORATORY

The Contracting Officer reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth herein, and to check the laboratory technicians testing procedures and techniques. The laboratory will be evaluated based on the criteria of ASTM E-548.

1.9.3 CAPABILITY RE-CHECK OF CONTRACTOR-FURNISHED FIELD LABORATORY

Should be laboratory fail the capability check, the Contractor will be assessed a charge of $1000 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequentially selected laboratory.

1.9.4 USE BY GOVERNMENT OF CONTRACTOR-FURNISHED FIELD LABORATORY

The Contracting Officer reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance test and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

1.10 TESTING PROGRAM

The frequency of the tests listed hereinafter is the minimum acceptable. Additional tests may be required to demonstrate compliance with the contract. The location of each test chosen shall be selected to provide adequate representation of the material being placed and to obtain the maximum coverage of each lift or layer placed. The listing of these tests does not relieve the Contractor of the responsibility for performing the

infrequent tests designated in other sections of these specifications. The Contracting Officer may select the time and location for any testing required under this contract., Standards indicated in parentheses are alternate testing standards essentially equal to the first method indicated. The Contractor shall identify which standard was used when submitting test results.

1.11 MAINTENANCE OF WORK

Maintenance of work shall be in accordance with Section 104 of VDOT Specifications

PLANT MIX ASPHALT PAVEMENTS

Fine Aggregate

Grain Size Analysis	AASHTO T-27	Cold feed,
1 test per 3 shifts		
Hot bin, 1 test per shift		
Oven Dry Bulk Specific Gravity	ASTM C-128	1 Test

Coarse Aggregate

Grain Size Analysis	AASHTO T-27	Cold feed,
1 test per 3 shifts		
Hot bin, 1 test per shift		
Oven Dry Bulk Specific Gravity	ASTM C-127	1 test

Bituminous Mixtures

Extraction of Bitumen AASHTO T-168	Sampling	1 test per shift
Extraction AASHTO T-164		
Mechanical Analysis of Extracted Aggregate	AASHTO T-30	1 test per shift

Pavement Sample (for Thickness) and Replace with new Material	Cut Full Depth from Compacted Pavement	1 per 10,000 SF

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

-- End of Section --

SECTION 02531A

SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 270	(2000) Mortar for Unit Masonry
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 828	(1998) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924M	Concrete Pipe Sewer Lines by Low Pressure Air Test Method (Metric)
ASTM C 972	(2000) Compression-Recovery of Tape Sealant
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(2000) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 2680	(1995a)Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(1999) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 714	(2000) Polyethylene (PE) Plastic pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1999) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2000) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data

NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 1.5 m outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 NOT USED

2.1.2 Plastic Pipe

Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite sewer piping shall conform to ASTM D 2680. Size 200 mm (8 inch) through 380 mm (15 inch) diameter.

2.1.2.1 ABS Pipe

ASTM D 2751.

2.1.2.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 380 mm (15 inch) or less in diameter. ASTM F 949 for corrugated sewer pipes with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 200 mm (8 inch) through 1200 mm (48 inch) diameters. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

2.1.2.3 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 450 mm (18 inch) through 3000 mm (120 inch). ASTM F 714, size 100 mm (4 inch)) through 1200 mm (48 inch). The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills.

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 Ductile Iron Pipe

Pipe shall conform to AWWA C151 unless otherwise shown or specified.

2.1.6 Cast Iron Soil Pipe

Cast iron soil pipe shall conform to ASTM A 74, Class SV, except where

Class XH is indicated.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 NOT USED

2.2.2 Fittings for Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

2.2.2.1 Fittings for ABS Pipe

ASTM D 2751.

2.2.2.2 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

2.2.3 NOT USED

2.2.4 NOT USED

2.2.5 Fittings for Ductile Iron Pipe

Mechanical fittings shall conform to AWWA C110, rated for 1.03 MPa (150 psi). Push-on fittings shall conform to AWWA C110and AWWA C111, rated for 10.3 MPa (150 psi).

2.2.6 Fittings for Cast Iron Soil Pipe

ASTM A 74.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

2.3.1 NOT USED

2.3.2 Plastic Pipe Jointing

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

2.3.2.1 ABS Pipe Jointing

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 300 mm (12 inches) or less in diameter, dimensions and tolerances in accordance with Table 2 of ASTM D 2751.

2.3.3 NOT USED

2.3.4 NOT USED

2.3.5 Ductile Iron Pipe Jointing

Push-on joints shall conform to AWWA C111. Mechanical joints shall conform to AWWA C111 as modified by AWWA C151. Flanged joints shall conform to AWWA C115.

2.3.6 Cast Iron Soil Pipe Jointing

Rubber gaskets for compression joints shall conform to ASTM C 564. Packing material for caulked joints shall be twisted jute or oakum, tarred type, or asphalt-saturated cellulose-fiber. Joints for acid resisting cast iron soil pipe shall be made with acid resistant non-asbestos packing. The packing shall not contain material which would affect adhesion of the joint sealing material to the pipe. Lead shall be suitable for caulking of joints.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg (400 pounds). Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478 or ASTM C 478M. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.6 STEPS

Manufactured from deformed, 13 mm steel reinforcement rod complying with ASTM A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with step at 300 to 400 intervals. Omit steps for structures less than 1.5 meters deep.

2.7 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.7.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in

manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.7.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 28 MPa at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 17 MPa minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.8 STRUCTURES

2.8.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 3 m to a water-supply main or service line, except that where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, the horizontal spacing may be a minimum of 2 m. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 3 m on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 1 m to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 100 mm.

3.1.1.2 Roads, Railroads, and Airfields

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be as specified for storm drains in Section 02630 STORM-DRAINAGE SYSTEM. A minimum clearance of at least 50 mm between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with the corrosion protection as required for the conditions encountered at the site of installation.

3.1.1.3 Structural Foundations

Where sewer pipe is to be installed within 1 m of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.

d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.

e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Caulked Joints

The packing material shall be well packed into the annular space to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of 25 mm after caulking.

3.1.2.2 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.5 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.6 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for concrete pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924M, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 600 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured.

Leakage as measured by either the infiltration test or exfiltration test shall not exceed 94 L per 1 mm diameter per km of pipeline per day . When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 92.5 percent of the inside diameter of the pipe, but 95 percent for RPMP and RTRP. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4.0 degrees C (39.2 degrees F), and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 6 mm (1/4 inch) minimum diameter steel shaft having a yield strength of 480 MPa (70,000 psi) or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be spaced so that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe, or 5 percent for RTRP and RPMP, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty

construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 MANHOLE DETAILS

3.4.1 General Requirements

Manholes shall be constructed of concrete or precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 100 mm per meter nor more than 200 mm per meter. Free drop inside the manholes shall not exceed 500 mm, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 500 mm.

3.4.2 NOT USED

3.4.3 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.4.4 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 50 mm higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole

sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.4.5 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 50 mm adjusting rings. The bottom section shall be 305 mm in height. A 152 mm high top section will cover up to two, 50 mm adjusting rings. A 305 mm high bottom section will cover up to six, 50 mm adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 50 mm and shall be overlapped by the top section by 50 mm.

3.5 CONNECTING TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 1.5 m outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 1.5 m from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

SECTION 02630A

STORM-DRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 198	(1998) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(1999) Manual for Railway Engineering (4 Vol.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48M	(1994 el) Gray Iron Castings (Metric)
ASTM A 536	(1999el) Ductile Iron Castings
ASTM C 76M	(1999a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(1997) Mortar for Unit Masonry
ASTM C 425	(1998b) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443M	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 507M	(1999) Reinforced Concrete Elliptical

	Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 655	(1995a) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 828	(1998) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 877M	(1994) External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 923	(1998) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Materials
ASTM C 924M	(1998) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method (Metric)
ASTM C 1103M	(1994) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(1989; R 1995) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and

	Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F 679	(1995) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 794	(1999) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	(1999) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F 1417	(1992; R 1998) Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified. Plastic or PVC culvert pipe is not permitted under pavements or roadways.

2.1.1 Concrete Pipe

ASTM C 76M , Class III, or ASTM C 655, D-Load.

2.1.1.1 NOT USED

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

ASTM C 507M. Horizontal elliptical pipe shall be Class HE-A, and HE-III. Vertical elliptical pipe shall be Class VE-III.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.8.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.8.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.2 NOT USED

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 28 MPa concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 37.5 mm. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 25 mm thick for covers and not less than 40 mm thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 75 mm between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used

within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 NOT USED

2.3.4 NOT USED

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478M. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure or made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 NOT USED

2.3.7 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48M, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B, Alloy 356. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3.8 Joints

2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443M . Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 1.35 m (54 inches).

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443M. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.8.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877M.

2.3.8.3 NOT USED

2.3.8.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.4 STEPS

Manufactured from deformed, 13 mm steel reinforcement rod complying with ASTM A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with step at 300 to 400 mm intervals. Omit steps for structures less than 1.5 meters deep.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48M, Class 30B or 35B. Shape and size shall be as indicated.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 "Excavation, Trenching, and Backfilling for Utilities Systems" and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 300 mm to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 200 mm or 13 mm for each meter of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe

is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 02316 "Excavation, Trenching, and Backfilling for Utilities Systems".

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 NOT USED

3.2.3 NOT USED

3.2.4 NOT USED

3.2.5 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in

water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Corrugated Steel and Aluminum Alloy	5
Concrete-Lined Corrugated Steel	3
Ductile Iron Culvert	3
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.3.1 Concrete, PVC, Ribbed PVC and Ductile Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 NOT USED

3.3.3 NOT USED

3.3.4 NOT USED

3.3.5 NOT USED

3.3.6 NOT USED

3.3.7 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 1 meter apart, whichever is less.

3.3.8 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Manual.

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 NOT USED

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 200 mm apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 15 mm, thick and the width of the diaper band shall be at least 200 mm. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or

improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, or precast reinforced concrete, complete with frames and covers or gratings; and with fixed steps where indicated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 NOT USED

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 150 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 300 mm above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 200 millimeters. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 150 mm in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a

height of 300 mm above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 m, whichever is less. After the backfill has reached at least 300 mm above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 200 mm.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that

specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for concrete pipes shall conform to ASTM C 924M . Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924M , after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103M . Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 600 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 60 liters per mm in diameter per kilometer (250 gallons per inch in diameter per mile). When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

-- End of Section --

SECTION 02722A

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993el) Specific Gravity and Absorption of Course Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 NOT USED

1.2.3 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.3 NOT USED

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sampling and testing; G, RE
Field Density Tests; G, RE

Calibration curves and related test results prior to using the

device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557.

1.5.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density

calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

1.5.2.5 Wear Test

Wear tests shall be made on ABC and GCA course material in conformance with ASTM C 131.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

a. Sieve Analysis including 0.02 mm size material.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

1.5.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square meters, or portion thereof, of completed area.

b. Sieve Analysis shall be performed for every 500 metric tons, or portion thereof, of material placed.

c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

1.5.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ABC.

1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 2 degrees C. When the temperature falls below 2 degrees C, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The ABC shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, crushed recycled concrete, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the 4.75 mm sieve shall be known as coarse aggregate; that portion passing the 4.75 mm sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 1045 kg/cubic meter as determined by ASTM C 29/C 29M, and shall meet all the requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 25 mm and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 3
50.0 mm	----
37.5 mm	----
25.0 mm	100
12.5 mm	40-70
4.75 mm	20-50
2.00 mm	15-40
0.425 mm	5-25
0.075 mm	0-8

NOTE 1: Particles having diameters less than 0.02 mm shall not be in

excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the 0.425 mm sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the

requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC. Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 150 mm or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 150 mm is required, the material shall be placed in layers of equal thickness. No layer shall exceed 150 mm or less than 75mm when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

3.5.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The ABC shall be placed so that the completed section will be a minimum of 1.5 m wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer

edges of ABC in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 600 mm width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 97 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No individual layer shall exceed 150 mm nor be less than 75 mm in compacted thickness. The total compacted thickness of the ABC course shall be within 13 mm of the thickness indicated. Where the measured thickness is more than 13 mm deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 13 mm thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 6 mm of the thickness indicated. The total thickness of the ABC course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square meters of base course. Measurements shall be made in 75 mm diameter test holes penetrating the base course.

3.5.7 NOT USED

3.5.8 Finishing

The surface of the top layer of ABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the

top layer of base course to meet grade. If the elevation of the top layer of ABC is 13 mm or more below grade, then the top layer should be scarified to a depth of at least 75 mm and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 10 mm when tested with a 3.05 meter straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 15 meter intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Completed portions of the ABC course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

3.7 MAINTENANCE

The ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION 02748A

BITUMINOUS TACK AND PRIME COATS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 40	(1978; R 1996) Sampling Bituminous Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 140	(200) Sampling Bituminous Materials
ASTM D 2026	(1972; R 1997) Cutback Asphalt (Slow-Curing Type)
ASTM D 2397	(1998) Cationic Emulsified Asphalt
ASTM D 2995	(1999) Determining Application Rate of Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.3 NOT USED

1.4 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.4.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.4.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.5 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 10 degrees C or above and when the temperature has not been below 2 degrees C for the 12 hours prior to application.

PART 2 PRODUCTS

2.1 TACK COAT

Emulsified asphalt shall conform to ASTM D 2397 Grade CRS-1, CRS-2, CRS-1H OR CSS-1H.

2.2 PRIME COAT

Cutback asphalt shall conform to ASTM D 2026, Grade SC-70 or SC-250.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt,

clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.20 liter nor more than 0.70 liter per square meter of pavement surface.

3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.70 liter nor more than 1.80 liters per square meter of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm/sec, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

SC-250	75-132 degrees C

Paving Grade Asphalts

Penetration Grades

Viscosity Grades

Emulsions

SS-1h	20-70 degrees C
CRS-1	52-85 degrees C
CSS-1	20-70 degrees C

CSS-1h	20-70 degrees C

*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 8 meters of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. All traffic, except for paving equipment used in constructing the surfacing, shall be prevented from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

3.4.2 Prime Coat

The prime coat will be required if it will be at least seven days before a the surfacing (Asphalt cement hot mix concrete)layer is constructed on the underlying (base course, etc)compacted material. The type of liquid asphalt and application rate will be as specified herein. The Contractor shall protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Damage to the underlying material caused by lack of, or inadequate, protection shall be repaired (recompacted or replaced) by approved methods at no additional cost to the Government. If the Contractor options to use the prime coat, it shall be applied as soon as possible after consolidation of the underlying material. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

3.4.3 Tack Coat

Tack coat shall be applied at the locations shown on the drawings.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed

to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material used shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 30 meters for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.20 liters per square meter . Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 1.10 liters per square meter . Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

&

SECTION 02763A

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-1952 (Rev D; Canc. Notice 1) Paint, Traffic and Airfield Marking, Waterborne (Metric)

1.2 NOT USED

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements; G, RE

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

Qualifications

Document certifying that personnel are qualified for equipment operation and handling of chemicals.

SD-06 Test Reports

Sampling and Testing

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Volatile Organic Compound (VOC)

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.5.1 Paint Application Equipment

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 8 kilometers per hour (5 mph), and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.5.2 NOT USED

1.5.3 NOT USED

1.5.4 NOT USED

1.5.5 Surface Preparation Equipment

1.5.5.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 70.8 liters per sec (150 cfm) of air at a pressure of not less than 620 kPa (90 psi) at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.5.5.2 Waterblast Equipment

The water pressure shall be specified at 17.9 MPa (2600 psi) at 60 degrees C (140 degrees F in order to adequately clean the surfaces to be marked.

1.5.6 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.5.7 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.7 MAINTENANCE OF TRAFFIC

1.7.1 NOT USED

1.7.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.8 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 5 degrees C and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields, roads, and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 5 degrees C and less than 35 degrees C. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified . The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions

shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

a. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 2.9 plus or minus 0.5 square meter per liter.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.3 MARKING REMOVAL

Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

-- End of Section --

SECTION 02811

UNDERGROUND SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2287	(1996a) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASME INTERNATIONAL (ASME)

ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND SANITARY

RESEARCH (ASSE)

ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers
ASSE 1020	(1998) Pressure Vacuum Breaker Assembly (Recommended for Outdoor Usage)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C509	(1994; Addendum 1995) Resilient-Seated Gate Valves for Water Supply Service
AWWA C901	(1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-01	(1993) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems, Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

PLUMBING AND DRAINAGE INSTITURE (PDI)

PDI WH 201	(1992) Water Hammer Arresters

1.2 PERFORMANCE REQUIREMENTS

System shall operate with a minimum water pressure of 90% available pressure in mechanical room at connection to building and sufficient pressure at the last head in each zone to enable head to function as designed.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sprinkler System; G, RE

Detail drawings for valves, sprinkler heads, backflow preventers, automatic controllers, emitter heads, and water hammer arresters. Drawings shall include a complete list of equipment and materials, and manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed system layout, type and number of heads and emitters, zone valves, drain pockets, backflow devices, controllers, and mounting details of controllers. As-built Drawings which provide current factual information showing locations of mains, heads, valves, and controllers including deviations from and amendments to the drawings and changes in the work shall be included.

SD-03 Product Data

Framed Instructions; G, RE

Labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

Field Training; G, RE

Information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules and notification of training.

Sprinkler System; G, RE

Detailed procedures defining the Contractor's provisions for accident prevention, health protection, and other safety precautions for the work to be done.

Spare Parts; G, RE

Spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Design Analysis and Calculations; G, RE

Design analyses and pressure calculations verifying that system will provide the irrigation requirements.

SD-06 Test Reports

Field Tests; G, RE

Performance test reports, in booklet form, showing all field tests performed to adjust each component; and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of control valves.

SD-07 Certificates

Sprinkler System; G, RE

The material supplier's or equipment manufacturer's statement that the supplied material or equipment meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of material supplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply.

SD-10 Operation and Maintenance Data

Sprinkler System; G, RE

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to field testing and the remainder upon acceptance. Manuals shall be approved prior to the field training course. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout, simplified wiring and control diagrams of the system as installed, and system programming schedule.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be protected from the weather; excessive humidity and temperature variation; direct sunlight (in the case of plastic or rubber materials); and dirt, dust, or other contaminants.

1.5 FIELD MEASUREMENTS

The Contractor shall verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer who has produced similar systems which have performed well for a minimum period of 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 Extra Stock

The following extra stock shall be provided: Two sprinkler heads of each size and type, two valve keys for operating manual valves, two wrenches for removing and installing each type of head, two quick coupler keys and hose swivels, and four irrigation controller housing keys.

2.2 PIPING MATERIALS

2.2.1 NOT USED

2.2.2 NOT USED

2.2.3 NOT USED

2.2.4 Polyvinyl Chloride (PVC) Pipe, Fittings and Solvent Cement

2.2.4.1 PVC Pipe

Pipe shall conform to the requirements of ASTM D 1785, PVC 1120 Schedule 80; or ASTM D 2241, PVC 1120 SDR 21, Class 200.

2.2.4.2 PVC Fittings

Solvent welded socket type fittings shall conform to requirements of ASTM D 2466, Schedule 40. Threaded type fittings shall conform to requirements of

ASTM D 2464, Schedule 80.

2.2.4.3 Solvent Cement

Solvent cement shall conform to the requirements of ASTM D 2564.

2.2.5 Polyethylene (PE) Plastic Piping

Pipe shall conform to AWWA C901, outside diameter base with dimension ratio (DR) of 9.3 to provide 1034 kPa (150 psi) minimum pressure rating. Fittings shall conform to ASTM D 3261, DR of 9.3.

2.2.6 NOT USED

2.2.7 Emitter Hose and Distribution Tubing

Emitter hose and distribution tubing shall conform to ASTM D 2287, maximum inside diameter of 13 mm (1/2 inch), minimum wall thickness of 2.286 mm (90 mils), vinyl plastic extruded from non-rigid chloride, integrally algae-resistant, homogeneous throughout, smooth inside and outside, free from foreign materials, cracks, serrations, blisters and other effects. Slip fittings shall be provided.

2.3 SPRINKLER AND EMITTER HEADS

2.3.1 Pop-Up Spray Heads

2.3.1.1 General Requirements

Pop-up spray heads lay flush with housing, then pop up when water pressure 138 kPa is activated in system. The rising member supporting the nozzle shall be identical on full, half, third or quarter pattern sprinklers so that nozzles will be interchangeable. The sprinkler head shall be designed to be adjustable for coverage and flow. The nozzle shall be removable so head does not have to be removed for flushing or cleaning. Nozzle rises a minimum of 100 mm (4 inches) above the body. The body shall be constructed with a 13 mm female thread for installation in a fixed underground pipe system.

2.3.1.2 Shrubbery Sprinkler Heads

Sprinkler heads shall be conical spray with adjustable or non-adjustable coverage and designed for permanent aboveground mounting on riser or pop-ups at a height compatible with ground covers. Provide brass nozzles.

2.3.2 Rotary Pop-Up Sprinklers

Sprinklers shall be capable of ensuring complete coverage for the irrigated areas. Construction shall be high impact molded plastic with filter screen, reducible watering radius, and choice of 3 nozzles and have adjustable radius capabilities.

2.3.3 Bubbler Sprinkler Heads

Heads shall be multiple-spray bubbler with adjustable flow and designed for permanent aboveground mounting on risers.

2.3.4 Surface Connected Lawn Sprinkler Heads

Heads shall be an impulse type with or without sled, ring, or wheel base; multiple T Type; a rotary type with sled, spike or wheel base; or oscillating type with wheel or sled base.

2.3.5 Emitter Heads

Emitter heads shall be self-cleaning, pressure compensating diaphragm with one or six self-piercing barbed outlets; each capable of emitting from 1 to 8 L/hour (1/4 to 2 gallons per hour) flow. Emitter body shall be ultraviolet stabilized, algae, and heat resistant plastic construction.

2.4 VALVES

2.4.1 Gate Valves, Less than 80 mm (3 Inches)

Gate valves shall conform to the requirements of MSS SP-80, Type 1, Class 150, threaded ends.

2.4.2 Gate Valves, 80 mm (3 Inches) and Larger

Gate valves shall conform to the requirements of AWWA C509 and have encapsulated resilient wedge, parallel seats, non-rising stems, and open by counterclockwise turning. End connections shall be flanged. Interior construction of valves shall be bronze including stem containing a maximum 2 percent aluminum and maximum 16 percent zinc.

2.4.3 Angle Valves, Less Than 65 mm (2-1/2 Inches)

Angle valves shall conform to the requirements of MSS SP-80, Type 3, Class 150 soldered ends.

2.4.4 Angle Valves, 65 mm (2-1/2 Inches) and Larger

Angle valves shall conform to the requirements of MSS SP-85, Type II, Class 250 threaded or flanged ends.

2.4.5 Quick Coupling Valves

Quick coupling valves shall have brass parts and shall be two-piece unit consisting of a coupler water seal valve assembly and a removable upper body to allow spring and key track to be serviced without shutdown of main. Lids shall be lockable vinyl with spring for positive closure on key removal.

2.4.6 Remote Control Valves, Electrical

Remote control valves shall be solenoid actuated globe valves of 20 to 80 mm (3/4 to 3 inch) size, suitable for 24 volts, 60 cycle, and designed to

provide for shut-off in event of power failure. Valve shall be cast bronze or brass or plastic housing suitable for service at 1034 kPa (150 psi) operating pressure with external flow control adjustment for shut-off capability, external plug at diaphragm chamber to enable manual operation, filter in control chamber to prevent valve body clogging with debris, durable diaphragm, and accessibility to internal parts without removing valve from system.

2.4.7 Drain Valves

2.4.7.1 Manual Valves

Manual valves shall conform to requirements of MSS SP-80, Type 3, Class 150 threaded ends for sizes less than 65 mm (2-1/2 inches) and MSS SP-85, Type II, Class 250 threaded or flanged ends for sizes 65 mm (2-1/2 inches) and larger.

2.4.7.2 Automatic Valves

Automatic valves shall be brass or plastic, spring loaded ball drip type, Class 150 and threaded ends, designed to close at 18 kPa (6 foot) pressure head with positive seal at 21 kPa (3 psi) pressure or greater and be open to drain at less than 21 kPa (3 psi) pressure.

2.4.8 Pressure Regulating Master Valve

Pressure regulating master valve shall be automatic mechanical self-cleaning, self-purging control system having an adjustable pressure setting operated by a solenoid on alternating current with 0.70 amperes at 24 volts. Valve shall close slowly and be free of chatter in each diaphragm position, have manual flow stem to adjust closing speed and internal flushing, and two inlet tappings capable of being installed as a straight pattern valve. Body shall be cast bronze or brass with removable brass seat serviceable from top without removing valve body from system. Valve shall operate at 1034 kPa (150 psi) working pressure and pilot range from 70 to 875 kPa (10 to 125 psi).

2.4.9 Backflow Preventers

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE 1012. Reduced pressure principle backflow preventers shall be in accordance with ASSE 1013.

2.4.9.1 Pressure Type Vacuum Breaker

Vacuum breaker shall conform to the requirements of ASSE 1020 and shall be bronze or brass construction, with one or two check valves, vacuum relief, inlet and discharge shut-offs valves, field test cocks, and vacuum relief opening of greater diameter than unit.

2.4.9.2 Reduced Pressure Type Backflow Preventers

Backflow preventers shall be Class 150 flanged cast iron, or bronze, or brass mounted gate valve, 304 stainless steel or bronze, internal parts. Total pressure drop through complete assembly shall be a maximum of 70 kPa (10 psi) at rated flow. Piping shall be galvanized steel pipe and fittings. Strainers shall be bronze or brass construction with gasket caps. Units shall have 200-mesh stainless steel screen elements.

2.5 ACCESSORIES AND APPURTENANCES

2.5.1 Valve Keys for Manually Operated Valves

Valve keys shall be 15 mm (1/2 inch) diameter by 1000 mm long, tee handles and keyed to fit valves.

2.5.2 Valve Boxes and Concrete Pads

2.5.2.1 Valve Boxes

Valve boxes shall be cast iron, plastic lockable, or precast concrete for each gate valve, manual control valve and remote control valve. Box sizes shall be adjustable for valve used. Word "IRRIGATION" shall be cast on cover. Shaft diameter of box shall be minimum 130 mm (5-1/4 inches). Cast iron box shall have bituminous coating.

2.5.2.2 Concrete Pads

Concrete pads shall be precast or cast-in-place reinforced concrete construction for reduced pressure type backflow preventers.

2.5.3 Pressure Gauges

Pressure gauges shall conform to requirements of ASME B40.1, single style pressure gauge for water with 115 mm (4-1/2 inch) dial brass or aluminum case, bronze tube, gauge cock, pressure snubber, and siphon. Scale range shall be suitable for irrigation sprinkler systems.

2.5.4 Service Clamps

Service clamps shall be bronze flat, double strap, with neoprene gasket or "O"-ring seal.

2.5.5 Water Hammer Arresters

Water hammer arrester shall conform to the requirements of PDI WH 201; stainless steel construction with an encased and sealed bellows compression chamber.

2.5.6 Emitter Head Accessories

2.5.6.1 Strainer

Strainer shall be provided at inlet to each drip line. Strainer shall have stainless steel screen having equivalent of 140-mesh filtration capacity

and incorporate flush valves within strainer to clean screen without disassembling unit.

2.5.6.2 Pressure Regulator

Pressure regulator shall be provided at each drip system if supply pressure exceeds 350 kPa (50 psi).

2.5.6.3 Riser Adapters

Riser adapters shall be provided with a rigid piping system.

2.5.6.4 Tubing Stakes

Tubing stakes shall be plastic coated steel, or other non-corrosive strong material to secure tubing.

2.5.6.5 Emitter Outlet Check Valve (Bug Cap)

Check valves shall be provided at end of each emitter outlet distribution line. Valves shall permit free flow of water with minimum restriction; prevent back siphoning, entry of insects, and contamination into outlet ports.

2.5.6.6 Access Sleeve

Access sleeve shall be provided at buried emitters placed in covered boxes. Lids of access sleeve shall be secured with removable lugs. Drip hose in both vertical and horizontal axis shall be secured.

2.5.6.7 Closure Caps

Closure caps shall be in accordance with manufacturer's recommendations.

2.6 AUTOMATIC CONTROLLERS, ELECTRICAL

Controller shall conform to the requirements of NEMA ICS 2 with 120-volt single phase service, operating with indicated stations, and grounded chassis. Enclosure shall conform to NEMA ICS 6 Type 3R, with locking hinged cover, pedestal-mounted. Controller shall be programmed for various schedules by setting switches and dials equipped with the following features: A switch for each day of week for three schedules, allowing each station to be scheduled individually as to days of watering; a minute switch for each station with a positive increment range of 0 to 3 hours, set time within one percent; a switch allowing selected schedules to be repeated after each completion of initial watering schedule and allowing each operation to be scheduled throughout a 24-hour day; a circuit breaker for surge protection; and circuit for a 9-volt rechargeable NiCad battery.

2.7 ELECTRICAL WORK

Wiring and rigid conduit for electrical power shall be in accordance with NFPA 70, and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.8 CONCRETE MATERIALS

Concrete shall have a compressive strength of 17 MPa at 28 days as specified in Section 03300, CAST-IN-PLACE STRUCTURAL CONCRETE.

2.9 WATER SUPPLY MAIN MATERIALS

Tapping sleeves, service cut off valves, and connections to water supply mains shall be in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

2.10 INSULATING JOINTS

Insulating joints and dielectric fittings shall be in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

PART 3 EXECUTION

3.1 INSTALLATION

Sprinkler system shall be installed after site grading has been completed. Excavation, trenching, and backfilling for sprinkler system shall be in accordance with the applicable provisions of Section 02316, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

3.1.1 Trenching

Trench around roots shall be hand excavated to pipe grade when roots of 50 mm diameter or greater are encountered. Trench width shall be 100 mm minimum or 1-1/2 times diameter of pipe, whichever is wider. Backfill shall be hand tamped over excavation. When rock is encountered, trench shall be excavated 100 mm deeper and backfilled with silty sand (SM) or well-graded sand (SW) to pipe grade. Trenches shall be kept free of obstructions and debris that would damage pipe. Subsoil shall not be mixed with topsoil. Existing concrete walks, drives and other obstacles shall be bored at a depth conforming to bottom of adjacent trenches. Pipe sleeves for bored pipe shall be two pipe diameters larger than sprinkler pipe.

3.1.2 Piping System

3.1.2.1 Cover

Underground piping shall be installed to meet the minimum depth of backfill cover specified.

3.1.2.2 Clearances

Minimum horizontal clearances between lines shall be 100 mm for pipe 50 mm (2 inches) and less; 300 mm for 65 mm (2-1/2 inches) and larger. Minimum vertical clearances between lines shall be 25 mm.

3.1.2.3 Minimum Slope

Minimum slope shall be 50 mm per 10 m in direction of drain valves.

3.1.3 Piping Installation

3.1.3.1 Polyvinyl Chloride (PVC) Pipe

a. Solvent-cemented joints shall conform to the requirements of ASTM D 2855.

b. Threaded joints shall be full cut with a maximum of three threads remaining exposed on pipe and nipples. Threaded joints shall be made tight without recourse to wicks or fillers, other than polytetrafluoroethylene thread tape.

c. Piping shall be joined to conform with requirements of ASTM D 2774 or ASTM D 2855, and pipe manufacturer's instructions. Pipe shall be installed in a serpentine (snaked) manner to allow for expansion and contraction in trench before backfilling. Pipes shall be installed at temperatures over 5 degrees C.

3.1.4 Installation of Valves

3.1.4.1 Manual Valves

Valves shall be installed in a valve box extending from grade to below valve body, with a minimum of 100 mm cover measured from finish grade to top of valve stem.

3.1.4.2 Automatic Valves

Valve shall be set plumb in a valve box extending from grade to below valve body, with minimum of 100 mm cover measured from grade to top of valve. Automatic valves shall be installed beside sprinkler heads with a valve box.

3.1.4.3 Drain Valves

Entire system shall be manually or automatically drainable. Low points of system shall be equipped with drain valve draining into an excavation containing 0.03 cubic meter gravel. Gravel shall be covered with building paper then backfilled with excavated material and 150 mm of topsoil.

3.1.5 Sprinklers and Quick Coupling Valves

Sprinklers and valves shall be installed plumb and level with terrain.

3.1.6 Installation of Drip Irrigation System

3.1.6.1 Emitter Hose

Emitter laterals shall be buried 150 mm deep. Connections shall be solvent welded in accordance with manufacturer's recommendation to standard weight Schedule 40 PVC fittings and bushings. Hose shall be installed in a serpentine manner. When cutting hose, shearing tool such as a pipe cutter, knife, or shears shall be used. Manufacturer's recommended tool and procedures when punching hose for emitters shall be followed.

3.1.6.2 Emitter Heads

Emitters shall be installed in a plastic emitter box. Emitter on a rigid PVC nipple shall be connected to PVC drip lateral with a tee or elbow. Tubing shall be attached to barbed fitting and daylight distribution tubing at root ball secured with stake, with bug cap at end of secured distribution tubing. After installing emitters and before operating system, end of drip lateral shall be opened and flushed clean. The number of emitters on a line shall not exceed manufacturer's recommendations for that hose or distribution tubing size and length.

3.1.6.3 Tubing Stakes

Main irrigation line shall be secured with stakes where line is aboveground. Stakes shall be spaced to ensure that hose does not shift location in presence of foot traffic, operations, gravity on slope installations, or environmental effects. Discharge of the emitter distribution tubing shall be staked to ensure that discharge point of emitter will be maintained at specified position in relation to plant material to be irrigated.

3.1.7 Backflow Preventers

Backflow preventer shall be installed in new connection to existing water distribution system, between connection and control valves. Backflow preventer shall be installed with concrete pads.

3.1.7.1 Pressure Type Vacuum Breaker

Pressure type vacuum breaker shall be installed 300 mm above highest head.

3.1.7.2 Reduced Pressure Type

Pipe lines shall be flushed prior to installing reduced pressure device; device shall be protected by a strainer located upstream. Device shall not be installed in pits or where any part of device could become submerged in standing water.

3.1.8 Control Wire and Conduit

3.1.8.1 Wires

Low voltage wires may be buried beside pipe in same trench. Rigid conduit shall be provided where wires run under paving. Wires shall be number tagged at key locations along main to facilitate service. One control circuit shall be provided for each zone and a circuit to control sprinkler system.

3.1.8.2 Loops

A 300 mm loop of wire shall be provided at each valve where controls are connected.

3.1.8.3 Expansion and Contraction

Multiple tubes or wires shall be bundled and taped together at 6 m intervals with 300 mm loop for expansion and contraction.

3.1.8.4 Splices

Electrical splices shall be waterproof.

3.1.9 Automatic Controller

Exact field location of controllers shall be determined before installation. Coordinate the electrical service to these locations. Install in accordance with manufacturer's recommendations and NFPA 70.

3.1.10 Thrust Blocks

Concrete shall be placed so that sides subject to thrust or load are against undisturbed earth, and valves and fittings are serviceable after concrete has set. Thrust blocks shall be as specified in Section 02510 WATER DISTRIBUTION SYSTEM.

3.1.11 Backfill

3.1.11.1 Minimum Cover

Maximum depth of cover shall be 600 mm for 32 mm (1-1/4 inch) pipe or smaller; 450 mm for 40 to 50 mm (1-1/2 to 2 inch) pipe; 600 mm for 65 mm (2-1/2 inch) pipe or larger, 300 mm for low-voltage wires. Remainder of trench or pipe cover shall be filled to within 80 mm of top with excavated soil, and compact soil with plate hand-held compactors to same density as undisturbed adjacent soil.

3.1.11.2 Restoration

Top 80 mm shall be filled with topsoil and compacted with same density as surrounding soil. Lawns and plants shall be restored in accordance with Sections 02921 SEEDING, 02922 SODDING.

3.1.12 Adjustment

After grading, seeding, and rolling of planted areas, sprinkler heads shall be adjusted flush with finished grade. Adjustments shall be made by providing new nipples of proper length or by use of heads having an approved device, integral with head, which will permit adjustment in height of head without changing piping.

3.1.13 Disinfection

Sprinkler system fed from a potable water system shall be disinfected upstream of backflow preventer in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

3.1.14 Cleaning of Piping

Prior to the hydrostatic and operation tests, the interior of the pipe shall be flushed with clean water until pipe is free of all foreign materials. Flushing and cleaning out of system pipe, valves, and components shall not be considered completed until witnessed and accepted by Contracting Officer.

3.2 FIELD TESTS

All instruments, equipment, facilities, and labor required to conduct the tests shall be provided by Contractor.

3.2.1 Hydrostatic Pressure Test

Piping shall be tested hydrostatically before backfilling and proved tight at a hydrostatic pressure of 1034 kPa (150 psi) without pumping for a period of one hour with an allowable pressure drop of 35 kPa (5 psi). If hydrostatic pressure cannot be held for a minimum of 4 hours, Contractor shall make adjustments or replacements and the tests repeated until satisfactory results are achieved and accepted by the Contracting Officer.

3.2.2 Leakage Tests

Leakage tests for service main shall be in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

3.2.3 Operation Test

At conclusion of pressure test, sprinkler heads or emitter heads, quick coupling assemblies, and hose valves shall be installed and entire system tested for operation under normal operating pressure. Operation test consists of the system operating through at least one complete programmed cycle for all areas to be sprinkled.

3.3 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system. After as-built drawings are approved by Contracting Officer, controller charts and programming schedule shall be prepared. One chart for each controller shall be supplied. Chart shall be a reduced drawing of actual as-built system that will fit the maximum dimensions inside controller housing. Black line print for chart and a different pastel or transparent color shall indicate each station area of coverage. After chart is completed and approved for final acceptance, chart shall be sealed between two 0.505 mm (20 mil) pieces of clear plastic.

3.4 CLEANUP

Upon completion of installation of system, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 02821A

FENCING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 121	(1999) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(2000) Zinc-Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1997) Aluminum-Coated Steel Barbed Wire
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM F 626	(1996a) Fence Fittings
ASTM F 883	(1997) Padlocks
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(2000) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2000) All Timber products - Preservative Treatment by Pressure Processes
AWPA C4	(1999) Poles - Preservative Treatment by Pressure Processes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Chain Link Fence

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

SD-10 Operation and Maintenance Data

Electro-Mechanical Locks; G, RE
Gate Operator; G, RE

Six copies of operating and maintenance instructions, a minimum of 2 weeks prior to field training. Operating instructions shall outline the step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions shall include routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include the general gate layout, equipment layout and simplified wiring and control diagrams of the system as installed.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 2, zinc-coated steel wire with minimum coating weight of 610 grams of zinc per square meter of coated surface, or ASTM A 491, Type

I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 50 mm mesh. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 2.44 m wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II , roll-formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 Wood Posts

Wood posts shall be cut from sound and solid trees free from short or reverse bends in more than one plane. Tops shall be convex rounded or inclined. Posts shall be free of ring shake, season cracks more than 6 mm wide, splits in the end, and unsound knots. Size and shape of posts shall be as indicated. Posts shall be treated in accordance with AWPA C1 or AWPA

C4 as applicable.

2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 42 mm (1-21/32 inch) , conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

2.5 WIRE

2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 2 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.7 NOT USED

2.8 CONCRETE

ASTM C 94/C 94M, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.9 PADLOCKS

Padlocks shall conform to ASTM F 883, Type PO1, Options A, B, and G and Grade 6. All padlocks shall be keyed into master key system as specified in Section 08710 DOOR HARDWARE.

2.10 GATE OPERATOR

Electric gate operators for sliding gates shall be as follows: Electrical gate operators shall have a right angle gearhead instantly reversing motor with magnetic drum-type brake, friction disc clutch, reversing starter with thermal overload protection rated for 120v, and a chain-driven geared rotary-type automatic limit switch. Instant reversing drive motor, should a safety device operate when the gate is closing. The advanced two-way

safety reserving system shall have a digital current sensor continuously monitoring the meter current. If the gate is closing and hits a vehicle, the control panel detects the increased load and reverses the gate. If the gate is opening and hit a vehicle, it stops and awaits further command instructions. Gears shall consist of a hardened steel machine cut worm and mating bronze gear. All gears and bearings shall operate in a bath of oil. Gate operators with V-belt pulleys will not be allowed. Gate operators shall be equipped with an emergency release to allow the gate to be operated manually. The emergency release mechanism shall be capable of being locked in the engaged or disengaged position. Positive stops shall be provided on the gate tracks as a backup to the limit switches.

2.11 ELECTRO-MECHANICAL LOCKS

Electro-mechanical locking devices for sliding gates shall be solenoid actuated such that the deadbolt retracts when the solenoid is energized and remains electrically retracted until the gate is closed. The solenoid shall be the continuous duty type, rated for 120V ac, 60Hz operation. The locking device shall be unlockable by key and shall be keyed on both sides. Status of the electro-mechanical lock shall be monitored by two limit switches (integral to the locking device) wired in series. One switch shall monitor the deadlock lever and the other switch shall monitor the locking tongue. Gates with electro-mechanical locks shall also be provided with a remote keypad access system on each side of the gate.

PART 3 EXECUTION

3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 3 m (10 feet) . Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m (500 feet) . Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 50 mm clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION

3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm (18 inches) in rock. Where solid rock

is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 457 mm (18 inches) in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 25 mm (1 inch) greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 914 mm (3 feet) and shall be protected with drive caps when being set.

3.3.2 Posts for Farm Style Fence

For wood posts, the Contractor shall excavate to depth indicated and brace post until backfill is completed. Backfill shall be placed in layers of 229 mm or less, moistened to optimum condition, and compacted with hand tampers or other approved method. Posts shall be set plumb and in proper alignment. Metal posts shall be driven or set in concrete as indicated.

3.4 RAILS

3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 1.83 m (6 feet) in height. A center brace or 2 diagonal truss rods shall be installed on 3.66 m (12 foot) fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m (6 feet) high or less if a top rail is installed.

3.6 TENSION WIRES

Tension wires shall be installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 305 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 152 mm (6 inches) of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm (15 inch) intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm (15 inch) intervals and fastened to all rails and tension wires at approximately 305 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 50 mm plus or minus 13 mm above the ground.

3.8 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

3.8.1 General Requirements

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored to the posts in a manner to prevent easy removal with hand tools. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

3.9 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal. For farm style fencing, standard metal gate assemblies with frame and fittings necessary for complete installation or wood gates shall be furnished as shown.

3.10 NOT USED

3.11 GROUNDING

Fences shall be grounded as specified herein. Electrical equipment attached to the fence shall be grounded as specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL. Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 600 mm into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 300 to 450 m of length when fences are located in isolated places, and every 150 to 225 m when in proximity (30 m or less) to public roads, highways, and buildings. Where the fence consists of wooden posts and horizontal metal strands only, down conductors consisting of No. 8 copper wire or equivalent shall be run from the ground rod the full height of the fence and fastened to each wire, so as to be electrically continuous. The connection to ground shall be made from the post where it

is of metal and is electrically continuous with the fencing. All metal fences shall be grounded at or near points crossed by overhead lines, and at distances not exceeding 45 m on each side of line crossings.

-- End of Section --

SECTION 02840

ACTIVE VEHICLE BARRIERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

UNDERWRITERS LABORATORIES (UL)

UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.2 NOT USED

1.3 NAMEPLATES

Nameplate data shall be permanently attached to each vehicle barrier. The data shall be legibly marked on corrosion-resistant metal plates and shall consist of at least the following:

a. Manufacturer's name.

b. Model number.

c. Serial number.

d. Date of manufacture.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G, RE
Equipment; G, RE

Detail drawings containing complete wiring and schematic diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including foundation and clearances for maintenance and operation.

SD-03 Product Data

Vehicle Barriers; G, RE
Spare Parts; G, RE

A complete list of equipment, materials, including industrial standards used and how they apply to the applicable component and manufacturer's descriptive data and technical literature, catalog cuts, and installation instructions. Spare parts data for each different item of material and equipment used, after approval of the detail drawings. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Information necessary to document a minimum 1-year successful field operation performance history for each type of vehicle barrier installed.

SD-06 Test Reports

Field Testing; G, RE

Test reports in booklet form showing all field tests, including component adjustments and demonstration of compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Vehicle Barriers; G, RE
Operating and Maintenance Instructions; G, RE

Six copies of operation and maintenance manuals, a minimum of 2 weeks prior to field training. One complete set prior to performance testing and the remainder upon acceptance. Manuals shall be approved prior to acceptance. Operation manuals shall outline the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall include routine maintenance procedures, possible breakdowns and repairs, and troubleshooting

guide. The manuals shall include piping layout, equipment layout, and simplified wiring and control diagrams of the system as installed. The manuals shall also include hydraulic oil types to be used for ambient temperature ranges of minus 34 degrees C (minus 30 degrees F) to plus 66 degrees C (150 degrees F) to cover winter operation, summer operation, and ambient temperature ranges in between.

1.5 DELIVERY AND STORAGE

Components placed in storage shall be protected from the weather, humidity, and temperature variation, dirt and dust, or other contaminants. Structural materials shall be stored on sleepers or pallets and shall be protected from rust and objectionable materials such as dirt, grease, or oil.

1.6 SPARE PARTS

A manufacturer's standard recommended spare parts package, with current unit prices and source of supply complete with detailed manuals on parts replacement, shall be provided with each barrier to facilitate 1 year of normal operation. Particular consideration shall be given to system components which are not readily available from local or commercial sources and which are critical to the operation of the system.

PART 2 PRODUCTS

2.1 NOT USED

2.2 NOT USED

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 ELECTRICAL WORK

Motors, manual or automatic motor control equipment except where installed in motor control centers and protective or signal devices required for the operation specified herein shall be provided in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. All field wiring for loop detectors, communication lines, and power circuits shall have surge protection. Any wiring required for the operation specified herein, but not shown on the electrical plans, shall be provided under this section in accordance with Sections 16415 ELECTRICAL WORK, INTERIOR and 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.8 CONTROL PANEL

A control panel and control circuit shall be provided to interface between

all barrier control stations and the power unit. The control station is defined as the main control panel and the remote control panel as shown. The control circuit shall contain all relays, timers, and other devices or an industrial programmable controller programmed as necessary for the barrier operation. The control panel shall allow direct interface with auxiliary equipment such as card readers, remote switches, loop detectors, infrared sensors, and sliding gate limit switches. The enclosure shall be as indicated on the drawings. All device interconnect lines shall be run to terminal strips.

2.8.1 Voltage

The control circuit shall operate from a 120 volt 60 Hz supply. The control circuit voltage shall be 12 or 24 dc for all external control panels.

2.9 MISCELLANEOUS EQUIPMENT

2.9.1 NOT USED

2.9.2 Heater

A waterproof heater with a thermostat control and NEMA 4 junction box connection point shall be provided for de-icing and snow melting. The heater shall provide barrier operation to an ambient temperature of minus 40 degrees C (minus 40 degrees F).

2.9.3 NOT USED

2.9.4 Vertical Arm Gates (Traffic Arms)

Vertical arm gates shall have an opening and closing time of less than or equal to 15 seconds. The gates shall be capable of 15 duty cycles per hour as a minimum. Gate shall operate the arm through 90 degrees. Gate operators shall be supplied with single phase 120 volt motors. Each gate shall be capable of being operated from a remote open-close push button station. Gates shall have a hand-crank mechanism which will allow manual operation during power failures. Each gate shall be supplied with a handcrank. Gate arms shall be constructed out of wood, steel, fiberglass, or aluminum, as specified by the manufacturer for the given lengths as shown on the drawings. Gate arms shall be covered with 406 mm (16 inch) wide reflectorized red and white sheeting. Each gate shall be furnished with a spare gate arm. Gate operator cabinets shall be constructed of galvanized steel, or aluminum and shall be painted manufacturers standard color as approved. Each gate operator shall be provided with an obstruction detector that will automatically reverse the gate motor when an obstruction is detected. The obstruction detector shall be any of the following 3 types: An electronic loop vehicle detector buried in the road, a photocell electric eye mounted on the gate operator, or a safety strip mounted on the lower edge of the arm. The detector system shall be automatically deactivated when the arm reaches the fully lowered position. Slab size and anchorage for gate operator shall be per manufacturer requirements.

2.10 FINISH

Surfaces shall be painted in accordance with requirements of Section 09900 PAINTING, GENERAL except for materials supplied with manufacturer's standard finish. The barrier front shall have 100 mm wide reflective yellow stripes 100 mm apart.

2.11 CONCRETE

The concrete shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.12 WELDING

Welding shall be in accordance with AWS D1.1.

2.13 PAVEMENT

After placement of the vehicle barrier, the pavement sections shall be replaced to match the section and depth of the surrounding pavement. Pavement shall be warped to match the elevations of existing pavement. Positive surface drainage, away from the vehicle barrier, shall be provided by pavement slope.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with manufacturers instructions and in the presence of a representative of the manufacturer. Manufacturer's representative shall be experienced in the installation, adjustment, and operation of the equipment provided. The representative shall also be present during adjustment and testing of the equipment.

3.2 HYDRAULIC LINES

Buried hydraulic lines shall be placed in polyvinyl chloride (PVC) sleeves. Positive drainage shall be provided from the hydraulic power unit to the barrier for drainage of condensation within the PVC sleeve.

3.3 ELECTRICAL

All control power wiring requiring compression terminals shall use ring-style terminals. Terminals and compression tools shall conform to UL 486A. Roundhead screws and lockwashers shall be used to provide vibration-resistant connections. Connections between any printed circuit cards and the chassis shall be made with screw connections or other locking means to prevent shock or vibration separation of the card from its chassis. The electrical power supply breaker for the hydraulic power unit shall be capable of being locked in the power on and power off positions.

3.4 FIELD TESTING

Upon completion of construction, a field test shall be performed for each

vehicle barrier. The test shall include raising and lowering the barrier, both electrically and manually, through its complete range of operation. Each vehicle barrier shall then be continuously cycled for not less than 30 minutes to test for heat build-up in the hydraulic system. The Contracting Officer shall be notified at least 7 days prior to the beginning of the field test. The Contractor shall furnish all equipment and make all necessary corrections and adjustments prior to tests witnessed by the Contracting Officer. Any conditions that interfere with the proper operation of the barrier disclosed by the test shall be corrected at no additional cost to the Government. Adjustments and repairs shall be done by the Contractor under the direction of the Contracting Officer. After adjustments are made to assure correct functioning of components, applicable tests shall be completed.

3.5 FIELD TRAINING

A field training course shall be provided for designated operating staff members. Training shall be provided for a total period of not less than 1 hour of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance instructions.

-- End of Section --

SECTION 02870A

SITE FURNISHINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications shall be referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 48M	(1994el) Gray Iron Castings (Metric)
ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM F 1487	(1998) Standard Consumer Safety Performance Specification for Playground Equipment for Public Use

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings.

Site Furnishing Standards; G, RE

Drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

SD-03 Product Data

Site Furnishings; G, RE

Manufacturer's descriptive data and catalog cuts.

Installation; G, RE

Manufacturer's installation and maintenance instructions.

Materials; G, RE

A listing indicating the furnishings provided have been in proven satisfactory use for at least 2 years.

SD-04 Samples

Finish; G, RE

Two sets of color data for each furnishing displaying manufacturer's color selections and finishes, and identifying those colors and finishes proposed for use.

1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. The storage area shall be as designated. The materials shall be stored in a dry, covered area until installed.

1.4 INSPECTION

Site furnishings shall be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Unacceptable items shall be removed from the job site.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall be the standard products of a manufacturer regularly engaged in the manufacture of such products. The materials provided shall be of a type with proven satisfactory use for at least 2 years.

2.1.1 NOT USED

2.1.2 NOT USED

2.1.3 Metal

Metallic materials and products shall conform to Section 05500 MISCELLANEOUS METAL. Metal components shall be furnished with factory drilled holes. Components shall be free of excess weld and spatter. Metal components with holes that will not be filled by hardware or hidden by other components will be rejected.

2.1.3.1 Steel

Structural steel products shall conform to ASTM A 36/A 36M, ASTM A 500 and ASTM A 501.

2.1.3.2 Reinforcing Steel

Steel used for reinforcement shall be deformed billet steel Grade 40. Steel shall conform to ASTM A 615/A 615M.

2.1.3.3 Cast Iron

Cast iron shall conform to ASTM A 48M Class 35 or better. The Contractor shall provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.4 Wood

The Contractor shall provide premium grade wood free of knots; boards with eased edges and ends; and wood components with factory drilled holes. Components with holes that will not be filled by hardware or hidden by other components will be rejected.

2.1.4.1 Treatment

Wood that is not naturally rot and insect resistant shall be treated with standard procedures. Creosote, pentachlorophenol, tributyl tin oxide shall not be used in conformance with ASTM F 1487. Ammonium Copper Quat (ACQ) shall not be used for surfaces likely to contact the skin of small children.

2.1.4.2 Selection

Wood products shall be selected to withstand the climatic conditions of the region in which the site is located.

2.1.5 NOT USED

2.1.5.1 NOT USED

2.1.5.2 High Density Polyethylene

The Contractor shall provide panels and components molded of ultraviolet (UV) and color stabilized polyethylene, with minimum 6 mm wall thickness; exposed edges shall be smoothed, rounded, and free of burrs and points; and the material shall be resistant to fading, cracking, fogging, and

shattering. The material shall be non-toxic and have no discernible contaminates such as paper, foil, or wood. The material shall contain no more than 3 percent air voids. Material shall be resistant to deformation from solar radiation heat gain.

2.1.5.3 Structural Component

Recycled materials to include plastic lumber will not be used as structural components of site furnishings.

2.2 HARDWARE

Hardware shall be stainless steel or galvanized steel in accordance with ASTM A 153/A 153M and compatible with the material to which applied. All exposed hardware shall match in color and finish. Mounting hardware shall be concealed, recessed, and plugged.

2.3 ANCHORS

Anchors shall be provided, where necessary, for fastening site furnishings securely in place and in accordance with approved manufacturer's instructions. Anchoring devices that may be used, when no anchors are otherwise specified or indicated, include anchor bolts, slotted inserts, expansion shields for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; and lag bolts and screws for wood.

2.4 FINISH

Finish shall be as specified by the manufacturer or as indicated. Exposed surfaces and edges shall be rounded, polished, or sanded. Finish shall be non-toxic, non-glare, and resistant to corrosion. Exposed surfaces shall be smooth and splinter-free exposed surfaces.

2.4.1 Coatings

2.4.1.1 Galvanizing

Galvanized components shall be hot-dipped in zinc after fabrication in accordance with ASTM A 123/A 123M. Tailings and sharp protrusions formed as a result of the hot-dip process shall be removed and exposed edges burnished.

2.4.2 Wood Sealants

Exposed wood surfaces shall have, as a minimum, two shop coats of paint, varnish, sealer, or other approved preservative. Sealants shall seal all applied surfaces from air.

2.4.3 Paint

Paint shall be factory applied with a minimum of 2 coats. Paint shall be weather-resistant and resistant to cracking, peeling and fading.

2.4.4 Color

Color of site furnishing components shall be in accordance with Section 09915 COLOR SCHEDULE.

2.5 SITE FURNISHING STANDARDS

Site furnishings shall be furnished with the dimensions and requirements indicated.

2.5.1 NOT USED

2.5.2 Benches and Chairs

Benches and chairs shall be furnished with no sharp edges or protruding hardware.

2.5.2.1 Height of Benches and Chairs

The height above finished grade or specified surface shall be between 450-500 mm and level.

2.5.2.2 Seat

The seat surface shall be pitched or slotted to shed water; the seat depth shall be between 300-460 mm and pitched down at the back at a 0-5 degree angle. Seat shall have a minimum width of 610 mm per person, and shall overhang the support base by a minimum of 100 mm for heel space and to facilitate rising from a seating position.

2.5.2.3 Back Rest

When back rests are required, the height shall be between 380-460 mm from the top of the seat and the connection shall be at a 90-110 degree angle to the seat.

2.5.2.4 NOT USED

2.5.2.5 Weight Limit

Seats shall support a minimum 136 kg for each person they are designed to accommodate.

2.5.3 NOT USED

2.5.4 Trash and Litter Receptacles

Trash and litter receptacles shall be furnished with weather protection, odor containment, and insect/animal-proofing. Container size shall be as directed.

2.5.4.1 Height

Trash and litter deposit openings shall be between 800-1000 mm above the ground.

2.5.4.2 Liners

Trash and litter receptacles shall be furnished with removable/reusable inner containers. Self-dumping type designs to include hinged bottom, top or sides will be rejected.

2.5.4.3 Anchors

Trash and litter receptacles that can be anchored to resist overturning by typical use, high winds, or animals shall be furnished and anchored in accordance with the manufacturer's recommendations.

2.5.4.4 Openings

Openings for trash and litter insertion shall be a minimum of 100 mm in diameter. Edges of the openings shall be crimped, rounded and smoothed.

2.5.5 Ash Receptacles

The Contractor shall provide ash receptacles with a fire-proof metal bowl or screen or sand-filled containers for ash containment. Ash receptacles shall have a minimum diameter of 200 mm ; ash containers shall have a fire-proof metal bowl or screen and shall be easily removable for cleaning.

2.5.6 NOT USED

2.5.7 NOT USED

2.5.8 Tree Grates

Tree grates shall be supplied complete with matching frame. Tree grates and frames shall have factory applied finish.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true in accordance with the approved manufacturer's instructions.

3.1.1 NOT USED

3.1.2 NOT USED

3.1.3 Application of Field Finishes

Where indicated, field finishes shall be applied in accordance with Section 09900 PAINTING, GENERAL.

3.1.4 Parts

New parts shall be acquired from the manufacturer. Substitute parts will not be accepted unless approved by the manufacturer.

3.1.5 Assembly

When the inspection of parts has been completed, the site furnishings shall be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly shall not interfere with other operations or pedestrian and vehicular circulation.

3.1.6 Testing

Each site furnishing shall be tested to determine a secure and correct installation. A correct installation shall be according to the manufacturer's recommendations and by the following procedure: The Contractor shall measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply shall be reinstalled. Fasteners and anchors determined to be non-compliant shall be replaced. A written report describing the results of the testing shall be provided.

3.2 RESTORATION AND CLEAN UP

When the installation has been completed, the Contractor shall clean up and protect the site. Existing areas that have been damaged from the installation operation shall be restored to original condition at Contractor's expense.

3.2.1 Clean Up

The site shall be cleaned of all materials associated with the installation. Site furnishing surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be according to manufacturer's instructions or as indicated.

3.2.2 Protection

The area shall be protected as required or directed by providing barricades and signage. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

3.2.3 Disposal of Materials

Excess and waste material shall be removed and disposed off Government property.

3.3 RE-INSTALLATION

Where re-installation is required, the following shall be accomplished:

a. Re-install the product as specified. Material acquisition of replacement parts is the responsibility of the Contractor.

Provide replacement materials that are new and supplied by the original manufacturer to match.

b. Damage caused by the failed installation shall be repaired.

-- End of Section --

SECTION 02921A

SEEDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 2028	(1976; R 1997) Cutback Asphalt (Rapid-Curing Type)
ASTM D 4972	(1995a) pH of Soils
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes
ASTM D 977	(1998) Emulsified Asphalt

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1995) Federal Seed Act Regulations Part 201

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
Surface Erosion Control Material

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

A listing of equipment to be used for the seeding operation.

Delivery

Delivery schedule.

Finished Grade and Topsoil

Finished grade status.

Topsoil

Availability of topsoil from the stripping and stock piling operation.

Quantity Check

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

SD-06 Test Reports

Equipment Calibration

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; G, RE

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Seed; G, RE
Topsoil
pH Adjuster
Fertilizer
Organic Material
Soil Conditioner
Mulch

Asphalt Adhesive

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.

c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.

d. Fertilizer. Chemical analysis and composition percent.

e. Organic Material: Composition and source.

f. Soil Conditioner: Composition and source.

g. Mulch: Composition and source.

h. Asphalt Adhesive: Composition.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to

species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-approved seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be in accordance with Virginia DOT Standards. Actual mix to be utilized shall be submitted to the Contracting Officer's Representative for approval.

2.1.3 Temporary Seed Species

Temporary seed species for surface erosion control or overseeding shall be in accordance with Virginia DOT Standards.

2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.1.5 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300A EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.250 mm sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.250 mm sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.250 mm sieve.

2.3.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.3.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

2.3.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.5.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be

sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrite, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

2.3.5.3 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 650 degrees C. Gradation: A minimum 90 percent shall pass a 2.36 mm sieve; a minimum 99 percent shall be retained on a 0.250 mm sieve; and a maximum 2 percent shall pass a 0.150 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter .

2.3.5.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.4.3 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.4.4 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.5 ASPHALT ADHESIVE

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

2.6 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

2.7 NOT USED

2.8 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

2.8.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

2.8.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 19 to 25 mm square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.8.3 Surface Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 605 grams per meter and 1200 mm wide with mesh openings of approximately 25 mm square.

2.8.4 NOT USED

2.8.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.8.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Seeding Time

Seed shall be installed to meet local growing conditions and in accordance with the Virginia DOT Standards.

3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300A EARTHWORK, prior to the commencement of the seeding operation.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied as recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The fertilizer shall be applied as recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test. The soil conditioner shall be spread uniformly over the soil a minimum 25 mm depth and thoroughly incorporated by tillage into the soil to a maximum 100 mm depth.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 100 mm depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 50 mm depth by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 25 mm below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 16 mm in any dimension shall be removed from the surface.

3.2.4.3 Field Area Debris

Debris and stones over a minimum 75 mm in any dimension shall be removed from the surface.

3.2.4.4 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Installing Seed

Seeding method shall be Broadcast Seeding or Hydroseeding. Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used

because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

3.3.1.1 Broadcast Seeding

Seed shall be uniformly broadcast in accordance with Virginia DOT Standards. Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 6 mm depth by disk harrow, steel mat drag, cultipacker, or other approved device.

3.3.1.2 NOT USED

3.3.1.3 Rolling

The entire area shall be firmed with a roller not exceeding 130 kilograms per meter roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.2 Hydroseeding

Seed shall be mixed to ensure broadcast at the rate of 195 kilograms per hectare . Seed and fertilizer shall be added to water and thoroughly mixed to meet the rates specified. The time period for the seed to be held in the slurry shall be a maximum 24 hours. Wood cellulose fiber mulch and tackifier shall be added at the rates recommended by the manufacturer after the seed, fertilizer, and water have been thoroughly mixed to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.3 Mulching

3.3.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 0.75 metric tons per hectare . Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.3.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.3.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 666 to 866 liters per hectare . Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

3.3.3.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 666 to 866 liters per hectare , using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.3.6 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.3.4 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 25 mm depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.4 SURFACE EROSION CONTROL

3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

3.4.2 Temporary Seeding

The application rate shall be 0.2 kilograms per square meter. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Paragraph SEED.

3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2

of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

3.4.2.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing seed.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 NOT USED

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.7.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430A EXTERIOR SIGNAGE.

3.9 SEED ESTABLISHMENT PERIOD

3.9.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of seeding work under this contract and shall continue through the remaining life of the contract and end 4 months after the last day of the seeding operation required by this contract. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be coordinated with Sections 02922A SODDING, and 02930A EXTERIOR PLANTING. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate

completion dates of areas.

3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 25 mm high.

3.9.2.1 Lawn Area

A satisfactory stand of grass plants from the seeding operation for a lawn area shall be a minimum 1000 grass plants per square meter. Bare spots shall be a maximum 230 mm square. The total bare spots shall be a maximum 2 percent of the total seeded area.

3.9.2.2 Field Area

A satisfactory stand of grass plants from the seeding operation for a field area shall be a minimum 1000 grass plants per square meter . The total bare spots shall not exceed 2 percent of the total seeded area.

3.9.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.9.3.1 Mowing

a. Lawn Areas: Lawn areas shall be mowed to a minimum 75 mm height when the turf is a maximum 100 mm high. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

b. Field Areas: Field areas shall be mowed once during the season to a minimum 75 mm height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.9.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 4 kilograms per hectare of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

3.9.3.3 NOT USED

3.9.3.4 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.9.3.5 Maintenance Record

A record of each site visit shall be furnished, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

-- End of Section --

SECTION 02922A

SODDING

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 4972	(1995a) pH of Soils
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

A listing of equipment to be used for the sodding operation. Manufacturer's literature including physical characteristics, application and installation instructions for equipment and chemical treatment material.

Delivery

Delivery schedule.

Finished Grade and Topsoil

Finished grade status.

Topsoil

Availability of topsoil from the stripping and stock piling operation.

Quantity Check

Bag count or bulk weight measurements of material used compared

with area covered to determine the application rate and quantity installed. The quantity of sod used shall be compared against the total area installed.

Sod Establishment Period

Calendar time period for the sod establishment period. When there is more than one sod establishment period, the boundaries of the sodded area covered for each period shall be described.

Maintenance Record

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

SD-06 Test Reports

Equipment Calibration

Certification of calibration tests conducted on the equipment used in the sodding operation.

Soil Test; G, RE

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Sod;
Topsoil;
pH Adjuster;
Fertilizer;
Organic Material;
Soil Conditioner;

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

a. Sod. Classification, botanical name, common name, mixture percentage of species, percent purity, quality grade, field location and state certification.

b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.

c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.

d. Fertilizer. Chemical analysis and composition percent.

e. Organic Material: Composition and source.

f. Soil Conditioner: Composition and source.

1.3 SOURCE INSPECTION

The sources of sod material and delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Sod

Sod shall be protected during delivery to prevent desiccation, internal heat buildup, or contamination.

1.4.1.2 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.3 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.2 Inspection

Sod shall be inspected upon arrival at the job site for conformity to species. Sod shall be checked for visible broadleaf weeds, and a visible consistency with no obvious patches of foreign grasses that exceed 2 percent of the canopy. Sod that is heating up, dry, moldy, yellow, irregularly shaped, torn, or of uneven thickness shall be rejected. Other materials shall be inspected for compliance with specified requirements. Open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter; and topsoil that contains viable plants and plant parts, shall be rejected. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

1.4.3.1 Sod

Sod shall be stored in designated areas and kept in a moist condition by watering with a fine mist, and covered with moist burlap, straw, or other covering. Covering shall allow air to circulate, preventing internal heat from building up. Sod shall be protected from exposure to wind and direct sunlight until installed.

1.4.3.2 Other Material Storage

Materials shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations, away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with sod operation materials.

1.4.4 Handling

Sod shall not be damaged during handling. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Time limitation between harvesting and installing sod shall be a maximum 36 hours.

PART 2 PRODUCTS

2.1 SOD

2.1.1 Sod Classification

State-approved sod shall be provided as classified by applicable state laws. Sod section shall be sized to permit rolling and lifting without breaking.

2.1.2 Grass Species

Grass species shall be proportioned in accordance with Virginia DOT Standards.

2.1.3 Quality

Sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 25 mm in diameter, woody plant roots, and other materials detrimental to a healthy stand of grass plants. Broadleaf weeds and patches of foreign grasses shall be a maximum 2 percent of the sod section.

2.1.4 Thickness

Sod shall be machine cut to a minimum 35 mm thickness. Measurement for thickness shall exclude top growth and thatch.

2.1.5 Anchors

Sod anchors shall be as recommended by the sod supplier.

2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300A EARTHWORK. When additional topsoil is required beyond the available topsoil from stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the sod species specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash, or other material over a maximum 40 mm diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material, and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.250 mm sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.250 mm sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.250 mm sieve.

2.3.2 Fertilizer

It shall be as recommended by the soil test. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall

be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test. Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Organic Material

Organic material shall consist of either bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume straw, sawdust, or other bedding materials. Manure shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

2.3.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material free of stones, sticks, soil, and toxic substances harmful to plants, fully composted or stabilized with nitrogen.

2.4 WATER

Water shall be the responsibility of the Contractor unless otherwise noted. Water shall not contain elements toxic to plant life.

PART 3 EXECUTION

3.1 INSTALLING SOD TIME AND CONDITIONS

3.1.1 Sodding Time

Sod shall be installed from at any time the ground is not forzen and quantity sod is readily available.

3.1.2 Sodding Conditions

Sodding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the sodding operations,

proposed alternate times shall be submitted for approval.

3.1.3 Equipment Calibration

Immediately prior to the commencement of sodding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. Provide calibration test results within one week of testing.

3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the sod species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300A EARTHWORK.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied at the rate recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 100 mm deep. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 50 mm deep by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes

1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 25 mm below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be rolled and completed with a light raking to remove from the surface debris and stones over a minimum 16 mm in any dimension.

3.2.4.2 Protection

Areas within the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing sod, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Areas shall be sodded as indicated. Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a maximum 25 mm depth.

3.3.1 Installing Sod

Rows of sod sections shall be placed parallel to and tightly against each other. Joints shall be staggered laterally. The sod sections shall not be stretched or overlapped. All joints shall be butted tight. Voids and air drying of roots shall be prevented. Sod sections shall be laid across the slope on long slopes. Sod sections shall be laid at right angles to the flow of water in ditches. Sod sections shall be anchored on slopes steeper than 3-horizontal-to-1-vertical. Anchoring may be required when surface weight or pressure upon placed sod sections is anticipated to cause lateral movement. Sod anchors shall be placed a minimum 600 mm on center with a minimum 2 anchors per sod section.

3.3.2 Finishing

Displacement of the sod shall be prevented by tamping or rolling the sod in place and knitting the sod to the soil. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed, and holes or missing corners shall be patched with sod.

3.3.3 Rolling

The entire area shall be firmed with a roller not exceeding 130 kilograms per meter roller width. Slopes over a maximum 3-horizontal-to-1 vertical

shall not be rolled.

3.3.4 Watering Sod

Watering shall be started immediately after completing each day of installing sod. Water shall be applied at least 3 times per week to supplement rainfall, at a rate sufficient to ensure moist soil conditions to a minimum depth of 25 mm . Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or plant material shall be prevented.

3.4 TEMPORARY SEEDING

The application rate shall be 0.2 kilograms per square meter. When directed during contract delays affecting the sodding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded with annual seed in accordance with Section 02921A SEEDING. When there is no Section 02921A SEEDING provided in the project, an annual seed species and application rate shall be submitted for approval.

3.4.1 Soil Amendments, Tillage and Watering

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Sod as required.

3.4.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing sod.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of the material used shall be compared with the total area covered to determine the rate of application. The quantity of sod used shall be compared against the total area established with sod. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 NOT USED

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the sodding operation shall be restored to original condition at Contractor's expense.

3.7.2 Clean Up

Excess and waste material shall be removed from the sodded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the sodding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be in accordance with Section 10430A EXTERIOR SIGNAGE.

3.9 SOD ESTABLISHMENT PERIOD

3.9.1 Commencement

The sod establishment period to obtain a healthy stand of grass plants shall commence on the first day of sodding work under this contract and shall continue through the remaining life of the contract and end 4 months after the last day of sodding operation required by this contract. Written calendar time period shall be furnished for the sod establishment period. When there is more than 1 sod establishment period, the boundaries of the sodded area covered for each period shall be described. The sod establishment period should be coordinated with Sections 02921A SEEDING, and 02930A EXTERIOR PLANTING. The sod establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health. A satisfactory stand of grass plants from the sodding operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum 50 mm square. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.

3.9.3 Maintenance During Establishment Period

Maintenance of the sodded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.9.3.1 Mowing

Sodded areas shall be mowed to a minimum 75 mm height when the turf is a maximum 100 mm height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.9.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 4 kilograms per hectare of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of

winter dormancy and shall be made without burning the installed grass plants.

3.9.3.3 NOT USED

3.9.3.4 Repair

Unsatisfactory stand of grass plants shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.9.3.5 Maintenance Record

A record of each site visit shall be furnished which describes the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

-- End of Section --

SECTION 02930A

EXTERIOR PLANTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300	(1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance

AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)

ANLA Z60.1	(1996) Nursery Stock

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 4972	(1995a) pH of Soils
ASTM D 5034	(1995) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D 5035	(1995) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes
ASTM D 5883	(1996el) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, RE

Scale drawings defining areas to receive plant materials.

Finished Grade, Topsoil and Underground Utilities; G, RE

Finished grade status; location of underground utilities and facilities; and availability of topsoil from the stripping and stock piling operation.

SD-03 Product Data

Geotextile; G, RE
Chemical Treatment Material; G, RE

Manufacturer's literature including physical characteristics, application and installation instructions for geotextile and chemical treatment material.

Equipment; G, RE

A listing of equipment to be used for the planting operation.

Delivery; G, RE

Delivery schedule.

Plant Establishment Period; G, RE

Calendar time period for the plant establishment period. When there is more than one establishment period, the boundaries of the planted areas covered for each period shall be described.

Maintenance Record; G, RE

Maintenance work performed, quantity of plant losses, and replacements; and diagnosis of unhealthy plant material.

Application of Pesticide; G, RE

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil; G, RE

Samples taken from several locations at the source.

Soil Amendments; G, RE

A 4.5 kg sample.

Mulch; G, RE

A 4.5 kg sample.

Geotextile; G, RE

A 150 mm square sample.

SD-06 Test Reports

Soil Test; G, RE
Percolation Test; G, RE

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Plant Material; G, RE
Topsoil; G, RE
pH Adjuster; G, RE
Fertilizer; G, RE
Organic Material; G, RE
Soil Conditioner; G, RE
Organic Mulch; G, RE
Mycorrhizal Fungi Inoculum; G, RE
Pesticide; G, RE

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

a. Plant Material: Classification, botanical name, common name, size, quantity by species, and location where grown.

b. Topsoil: Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.

c. pH Adjuster: Sieve analysis and calcium carbonate equivalent.

d. Fertilizer: Chemical analysis and composition percent.

e. Organic Material: Composition and source.

f. Soil Conditioner: Composition and source.

g. Organic Mulch: Composition, source, and treatment against fungi growth.

h. Mycorrhizal Fungi Inoculum: Plant material treated.

i. Pesticide. EPA registration number and registered uses.

SD-10 Operation and Maintenance Data

Maintenance Instructions; G, RE

Instruction for year-round care of installed plant material.

1.3 SOURCE INSPECTIONS

The nursery or source of plant material and the source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Plant Material Identification

Plant material shall be identified with attached, durable, waterproof labels and weather-resistant ink, stating the correct botanical plant name and size.

1.4.1.2 Protection During Delivery

Plant material shall be protected during delivery to prevent desiccation and damage to the branches, trunk, root system, or earth ball. Branches shall be protected by tying-in. Exposed branches shall be covered during transport.

1.4.1.3 Delivered Topsoil

Prior to the delivery of any topsoil, the availability of topsoil shall be verified in paragraph TOPSOIL. A soil test shall be provided for delivered topsoil.

1.4.1.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.5 Pesticide Material

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration number and the manufacturer's registered uses.

1.4.2 Inspection

Plant material shall be well shaped, vigorous and healthy with a healthy, well branched root system, free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement or abrasion. Plant material shall be checked for unauthorized substitution and to establish nursery grown status. Plant material showing desiccation, abrasion, sun-scald injury, disfigurement, or unauthorized substitution shall be rejected. The plant material shall exhibit typical form of branch to height ratio; and meet the caliper and height measurements specified. Plant material that measures less than specified, or has been poled, topped off or headed back, shall be rejected. Container-grown plant material shall show new fibrous roots and the root mass shall contain its shape when removed from the container. Plant material with broken or cracked balls; or broken containers shall be rejected. Bare-root plant material that is not dormant or is showing roots were pulled from the ground shall be rejected. Other materials shall be inspected for compliance with paragraph PRODUCTS. Open soil amendment containers or wet soil amendments shall be rejected. Topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material larger than 40 mm diameter shall be rejected. Topsoil that contains viable plant material and plant parts shall be rejected. Unacceptable material shall be removed from the job site.

1.4.3 Storage

1.4.3.1 Plant Material Storage

Plant material not installed on the day of arrival at the site shall be stored and protected in designated areas. Plant material shall not be stored longer than 30 days. Plant material shall be protected from direct exposure to wind and sun. Bare-root plant material shall be heeled-in. All plant material shall be kept in a moist condition by watering with a fine mist spray until installed.

1.4.3.2 Other Material Storage

Storage of other material shall be in designated areas. Soil amendments shall be stored in dry locations and away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with planting operation material.

1.4.4 Handling

Plant material shall not be injured in handling. Cracking or breaking the earth ball of balled and burlapped plant material shall be avoided. Plant material shall not be handled by the trunk or stems. Materials shall not be dropped from vehicles.

1.4.5 Time Limitation

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum 90 days. The time limitation between installing the plant material and placing the mulch shall be a maximum 24 hours.

1.5 WARRANTY

Furnished plant material shall have a warranty for plant growth to be in a vigorous growing condition for a minimum 12 month period. A minimum 12 month calendar time period for the warranty of plant growth shall be provided regardless of the contract time period. When plant material is determined to be unhealthy in accordance with paragraph PLANT ESTABLISHMENT PERIOD, it shall be replaced once under this warranty.

PART 2 PRODUCTS

2.1 PLANT MATERIAL

2.1.1 Plant Material Classification

The plant material shall be nursery grown stock conforming to ANLA Z60.1 and shall be the species specified.

2.1.2 Plant Schedule

The plant schedule shall provide botanical names as included in one or more of the publications listed under "Nomenclature" in ANLA Z60.1.

2.1.3 Substitutions

Substitutions will not be permitted without written request and approval from the Contracting Officer.

2.1.4 Quality

Well shaped, well grown, vigorous plant material having healthy and well branched root systems in accordance with ANLA Z60.1 shall be provided. Plant material shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems, which may occur from the digging and preparation for shipment, method of shipment, or shipment. Plant quality is determined by the growing conditions; method of shipment to maintain health of the root system; and growth of the trunk and crown as follows.

2.1.5 Growing Conditions

Plant material shall be native to or well-suited to the growing conditions of the project site. Plant material shall be grown under climatic conditions similar to those at the project site.

2.1.6 Method of Shipment to Maintain Health of Root System

2.1.6.1 Balled and Burlapped (BB) Plant Material

Ball size and ratio shall be in accordance with ANLA Z60.1. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. The plant stem or trunk shall be centered in the ball. All roots shall be clean cut at the ball surface. Roots shall not be pulled from the ground. Before shipment the root ball shall be dipped in gels containing mycorrhizal fungi inoculum. The root ball shall be completely wrapped with burlap or other suitable material and securely laced with biodegradable twine.

2.1.6.2 Balled and Potted (Pot) Plant Material

Ball size and ratio shall be in accordance with ANLA Z60.1. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. Removal shall be done by hand digging or mechanical devices. The plant stem or trunk shall be centered in the ball. All roots shall be clean cut at the ball surface. Roots shall not be pulled from the ground. Before shipment the root ball shall be dipped in gels containing mycorrhizal fungi inoculum. Container shall be used to retain the ball unbroken. Container shall be rigid to hold ball shape and protect root mass during shipping.

2.1.6.3 Balled and Platform (BP) Plant Material

Ball size and ratio shall be in accordance with ANLA Z60.1. Plants shall be prepared as balled and burlapped plant material and securely fastened to wood platform for shipping.

2.1.6.4 Bare-Root (BR) Plant Material

Minimum root spread shall be in accordance with ANLA Z60.1. A well branched root system characteristic of the species specified shall be provided. Roots shall not be pulled from the ground. Bare-root plant material shall be inoculated with mycorrhizal fungi during germination in the nursery. Before shipment the root system shall be dipped in gels containing mycorrhizal fungi inoculum. Bare-root plant material shall be dormant. The root system shall be protected from drying out.

2.1.6.5 Container-Grown (C) Plant Material

Container size shall be in accordance with ANLA Z60.1. Plant material shall be grown in a container over a duration of time for new fibrous roots to have developed and for the root mass to retain its shape and hold together when removed from the container. Container-grown plant material shall be inoculated with mycorrhizal fungi during germination in the nursery. Before shipment the root system shall be dipped in gels containing mycorrhizal fungi inoculum. The container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

2.1.7 Growth of Trunk and Crown

2.1.7.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANLA Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 150 mm from ground level.

c. Specimen: The tree provided shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

2.1.7.2 NOT USED

2.1.7.3 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANLA Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.7.4 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material shall have the height-to-spread ratio recommended by ANLA Z60.1. The coniferous evergreen trees shall not be "poled" or the leader removed. Acceptable plant material shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

2.1.7.5 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material shall have the height-to-spread ratio recommended by ANLA Z60.1. Acceptable plant material shall be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

2.1.7.6 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall have the minimum number of runners and length of runner recommended by ANLA Z60.1. Plant material shall have heavy, well developed and balanced crown with vigorous, well developed root system and shall be furnished in containers.

2.1.8 Plant Material Size

Plant material shall be furnished in sizes indicated. Plant material larger in size than specified may be provided at no additional cost to the Government.

2.1.9 Plant Material Measurement

Plant material measurements shall be in accordance with ANLA Z60.1.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300A EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the plant material specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite is not recommended.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.25 mm sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.25 mm sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.25 mm sieve.

2.3.2 Fertilizer

Fertilizer shall be controlled release commercial grade; free flowing, pellet or tablet form; uniform in composition; and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from

sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Organic Material

Organic material shall consist of either bonemeal, peat, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.3.3.1 Bonemeal

Bonemeal shall be a finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.3.2 Rotted Manure

Rotted manure shall be unleached horse, chicken, or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. Manure shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and shall be free of stones, sticks, and soil.

2.3.3.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, or other wood waste material free of stones, sticks, and toxic substances harmful to plants, and stabilized with nitrogen.

2.3.3.4 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from food, agricultural, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent or less by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 50 mm in length.

2.3.3.5 Worm Castings

Worm castings shall be screened from worms and food source and shall be commercially packaged.

2.3.4 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for single use or in combination to meet topsoil requirements for the plant material specified.

2.3.4.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.4.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized according to manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide with an absorption capacity of 250-400 times its weight.

2.3.4.3 Calcined Clay

Granular particles shall be produced from montmorillonite clay calcined to minimum temperature of 650 degrees C. Gradation: A minimum 90 percent passing 2.36 mm sieve; a minimum 99 percent shall be retained on 0.25 mm sieve; and a maximum 2 percent shall pass a 0.15 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter .

2.3.4.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.4.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure is not recommended to be used as a mulch because it would encourage surface rooting of the plant material and weeds.

2.4.1 NOT USED

2.4.2 Organic Mulch

Organic mulch materials shall be native to the project site and consist of recycled mulch, shredded bark, wood chips, or ground bark.

2.4.2.1 NOT USED

2.4.2.2 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

2.5 GEOTEXTILE

Geotextile shall be woven or nonwoven; polypropylene, polyester, or

fiberglass, mat in accordance with ASTM D 5034 or ASTM D 5035. It shall be made specifically for use as a fabric around plant material. Nominal weight shall be a minimum 120 grams per square meter . Permeability rate shall be a minimum 1 mm per second.

2.6 WOOD STAKING MATERIAL

Wood stakes shall be hardwood or fir; rough sawn; free from knots, rot, cross grain, or other defects that would impair their strength.

2.6.1 Bracing Stake

Wood bracing stakes shall be a minimum 50 x 50 mm square and a minimum 2400 mm long with a point at one end. Stake shall be set without damaging rootball.

2.6.2 Wood Ground Stakes

Wood ground stakes shall be a minimum of 50 x 50 mm square and a minimum 900 mm long with a point at one end.

2.6.3 Deadmen

Wood deadmen shall be a minimum 100 x 100 x 900 mm long.

2.7 METAL STAKING AND GUYING MATERIAL

Metal shall be aluminum or steel consisting of recycled content made for holding plant material in place.

2.7.1 Bracing Stakes

Metal bracing stakes shall be a minimum 25 mm diameter and a minimum 2400 mm long. Stake shall be set without damaging rootball.

2.7.2 Metal Ground Stakes

Metal ground stakes shall be a minimum 13 mm diameter and a minimum 900 mm long.

2.7.3 Earth Anchor

Metal earth anchors shall be a minimum 13 mm diameter and a minimum 600 mm long.

2.7.4 Guying Material

Metal guying material shall be a minimum 12 gauge wire. Multi-strand cable shall be woven wire. Guying material tensile strength shall conform to the size of tree to be held firmly in place.

2.7.5 Turnbuckle

Metal turnbuckles shall be galvanized or cadmium-plated steel, and shall be

a minimum 75 mm long with closed screw eyes on each end. Screw thread tensile strength shall conform to the size of tree to be held firmly in place.

2.8 PLASTIC STAKING AND GUYING MATERIAL

Plastic shall consist of recycled plastic product made for holding plant material firmly in place. Plastic shall not be used for deadmen.

2.8.1 Plastic Bracing Stake

Plastic bracing stakes shall be a minimum 50 mm diameter and a minimum 2400 mm long. Stake shall be set without damaging rootball.

2.8.2 Plastic Ground Stakes

Plastic ground stakes shall be a minimum 50 mm diameter and a minimum 900 mm long.

2.8.3 Plastic Guying Material

Plastic guying material shall be designed specifically for the purpose of firmly holding plant material in high wind velocities.

2.8.4 Chafing Guard

Plastic chafing guards shall be used to protect tree trunks and branches when metal is used as guying material. The material shall be the same color throughout the project site. Length shall be a minimum 1.5 times the circumference of the plant trunk at its base.

2.9 RUBBER GUYING MATERIAL

Rubber chafing guards, consisting of recycled material, shall be used to protect tree trunks and branches when metal guying material is applied. The material shall be the same color throughout the project. Length shall be a minimum 1.5 times the circumference of the plant trunk at its base.

2.10 FLAG

Plastic flag material shall be used on guying material. It shall be a minimum 150 mm long. Tape color shall be consistent and visually complimentary to the entire project area. The tape color shall meet pedestrian visual safety requirements for day and night.

2.11 TREE ROOT BARRIERS

Tree root barriers shall be metal or plastic consisting of recycled content. Barriers shall utilize vertical stabilizing members to encourage downward tree root growth. Barriers shall limit, by a minimum 90 percent, the occurrence of surface roots. Tree root barriers which are designed to be used as plant pit liners will be rejected.

2.12 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum shall be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

2.13 WATER

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall not contain elements toxic to plant life.

2.14 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

PART 3 EXECUTION

3.1 INSTALLING PLANT MATERIAL TIME AND CONDITIONS

3.1.1 Deciduous Plant Material Time

Deciduous plant material shall be installed from April 1 to June 1 for spring planting and from October 1 to December 1 for fall planting.

3.1.2 Evergreen Plant Material Time

Evergreen plant material shall be installed from April 1 to June 1 for spring planting and from October 1 to December 1 for fall planting.

3.1.3 Plant Material Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted for approval.

3.1.4 Tests

3.1.4.1 Percolation Test

Test for percolation shall be done to determine positive drainage of plant pits and beds. A positive percolation shall consist of a minimum 25 mm per 3 hours; when a negative percolation test occurs, a shop drawing shall be submitted indicating the corrective measures.

3.1.4.2 Soil Test

Delivered topsoil, excavated plant pit soil, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection onsite shall be random over the entire site. Sample collection

for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the plant material specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade, Topsoil and Underground Utilities

The Contractor shall verify that finished grades are as indicated on drawings, and that the placing of topsoil, the smooth grading, and the compaction requirements have been completed in accordance with Section 02300A EARTHWORK, prior to the commencement of the planting operation. The location of underground utilities and facilities in the area of the planting operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.2.2 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material locations may be adjusted to meet field conditions.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the planting area, the turf shall be covered and/or protected during planting operations. Existing trees, shrubs, and plant beds that are to be preserved shall be barricaded along the dripline to protect them during planting operations.

3.3 EXCAVATION

3.3.1 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to plant material location, type of plant and planting method shall be submitted for approval.

3.3.2 Turf Removal

Where the planting operation occurs in an existing lawn area, the turf shall be removed from the excavation area to a depth that will ensure the removal of the entire root system.

3.3.3 Plant Pits

Plant pits for ball and burlapped or container plant material shall be dug to a depth equal to the height of the root ball as measured from the base of the ball to the base of the plant trunk. Plant pits for bare-root plant material shall be dug to a depth equal to the height of the root system. Plant pits shall be dug a minimum 50 percent wider than the ball or root system to allow for root expansion. The pit shall be constructed with sides sloping towards the base as a cone, to encourage well aerated soil to

be available to the root system for favorable root growth. Cylindrical pits with vertical sides shall not be used.

3.4 INSTALLATION

3.4.1 Setting Plant Material

Plant material shall be set plumb and held in position until sufficient soil has been firmly placed around root system or ball. In relation to the surrounding grade, the plant material shall be set even with the grade at which it was grown.

3.4.1.1 Bare-Root Plant Material

Bare-root plant material shall be placed in water a minimum 30 minutes prior to setting.

3.4.2 Tree Root Barrier

Tree root barriers shall be installed as recommended by the manufacturer. Tree root barriers shall be used for trees located up to a maximum 1800 mm from paved surfaces or structures.

3.4.3 Backfill Soil Mixture

The backfill soil mixture may be a mix of topsoil and soil amendments suitable for the plant material specified. When practical, the excavated soil from the plant pit that is not amended provides the best backfill and shall be used.

3.4.4 Adding Mycorrhizal Fungi Inoculum

Mycorrhizal fungi inoculum shall be added as recommended by the manufacturer for the plant material specified.

3.4.5 Backfill Procedure

Prior to backfilling, all metal, wood, synthetic products, or treated burlap devices shall be removed from the ball or root system avoiding damage to the root system. The backfill procedure shall remove air pockets from around the root system. Additional requirements are as follows.

3.4.5.1 Balled and Burlapped, and Balled and Platformed Plant Material

Biodegradable burlap and tying material shall be carefully opened and folded back from the top a minimum 1/3 depth from the top of the root ball. Backfill mixture shall be added to the plant pit in 150 mm layers with each layer tamped.

3.4.5.2 Bare-Root Plant Material

The root system shall be spread out and arranged in its natural position. Damaged roots shall be removed with a clean cut. The backfill soil mixture shall be carefully worked in amongst the roots and watered to form a soupy

mixture. Air pockets shall be removed from around the root system, and root to soil contact shall be provided.

3.4.5.3 Container-Grown and Balled and Potted Plant Material

The plant material shall be carefully removed from containers that are not biodegradeable. Prior to setting the plant in the pit, a maximum 1/4 depth of the root mass, measured from the bottom, shall be spread apart to promote new root growth. For plant material in biodegradable containers the container shall be split prior to setting the plant with container. Backfill mixture shall be added to the plant pit in 150 mm layers with each layer tamped.

3.4.5.4 Earth Berm

An earth berm, consisting of backfill soil mixture, shall be formed with a minimum 100 mm height around the edge of the plant pit to aid in water retention and to provide soil for settling adjustments.

3.4.6 Plant Bed

Plant material shall be set in plant beds according to the drawings. Backfill soil mixture shall be placed on previously scarified subsoil to completely surround the root balls, and shall be brought to a smooth and even surface, blending to existing areas. Earth berms shall be provided. Polymers shall be spread uniformly over the plant bed and in the planting pit as recommended by the manufacturer and thoroughly incorporated into the soil to a maximum 100 mm depth.

3.4.7 Watering

Plant pits and plant beds shall be watered immediately after backfilling, until completely saturated.

3.4.8 Staking and Guying

Staking will be required when trees are unstable or will not remain set due to their size, shape, or exposure to high wind velocity.

3.4.8.1 One Bracing Stake

Trees 1200 to 1800 mm high shall be firmly anchored in place with one bracing stake. The bracing stake shall be placed on the side of the tree facing the prevailing wind. The bracing stake shall be driven vertically into firm ground and shall not injure the ball or root system. The tree shall be held firmly to the stake with a double strand of guying material. The guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. A chafing guard shall be used when metal is the guying material.

3.4.8.2 Two Bracing Stakes

Trees from 1800 to 2400 m height shall be firmly anchored in place with 2

bracing stakes placed on opposite sides. Bracing stakes shall be driven vertically into firm ground and shall not injure the ball or root system. The tree shall be held firmly between the stakes with a double strand of guying material. The guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. Chafing guards shall be used when metal is the guying material.

3.4.8.3 Three Ground Stakes

Trees over a minimum 2400 mm height and less than a maximum 150 mm caliper shall be held firmly in place with 3 bracing or ground stakes spaced equidistantly around the tree. Ground stakes shall be avoided in areas to be mowed. Stakes shall be driven into firm ground outside the earth berm. The guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. For trees over maximum 75 mm diameter at breast height, turnbuckles shall be used on the guying material for tree straightening purposes. One turnbuckle shall be centered on each guy line. Chafing guards shall be used when metal is the guying material.

3.4.9 Deadmen or Earth Anchors

Trees over a minimum 150 mm caliper shall be held firmly in place with wood deadmen buried a minimum 900 mm in the ground or metal earth anchors. Multi-strand cable guying material shall be firmly anchored at a minimum 1/2 tree height and shall prevent girdling. Turnbuckles shall be used on the guying material for tree straightening purposes. One turnbuckle shall be centered on each guy line. Chafing guards shall be used.

3.4.10 Flags

A flag shall be securely fastened to each guy line equidistant between the tree and the stake, deadmen, or earth anchor. The flag shall be visible to pedestrians.

3.5 FINISHING

3.5.1 Plant Material

Prior to placing mulch, the installed area shall be uniformly edged to provide a clear division line between the planted area and the adjacent turf area, shaped as indicated. The installed area shall be raked and smoothed while maintaining the earth berms.

3.5.2 Placing Geotextile

Prior to placing mulch, geotextile shall be placed as indicated in accordance with the manufacturer's recommendations.

3.5.3 Placing Mulch

The placement of mulch shall occur a maximum 48 hours after planting. Mulch, used to reduce soil water loss, regulate soil temperature and prevent weed growth, shall be spread to cover the installed area with a minimum 100 mm uniform thickness. Mulch shall be kept out of the crowns

of shrubs, ground cover, and vines and shall be kept off buildings, sidewalks and other facilities.

3.5.4 Pruning

Pruning shall be accomplished by trained and experienced personnel. The pruning of trees and palms shall be in accordance with ANSI A300. Only dead or broken material shall be pruned from installed plants. The typical growth habit of individual plant material shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

3.6 MAINTENANCE DURING PLANTING OPERATION

Installed plant material shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed to prevent desiccation and shall continue until the plant establishment period commences. Installed areas shall be kept free of weeds, grass, and other undesired vegetation. The maintenance includes maintaining the mulch, watering, and adjusting settling.

3.7 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.7.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.7.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.8 RESTORATION AND CLEAN UP

3.8.1 Restoration

Turf areas, pavements and facilities that have been damaged from the

planting operation shall be restored to original condition at the Contractor's expense.

3.8.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be cleared.

3.9 PLANT ESTABLISHMENT PERIOD

3.9.1 Commencement

The plant establishment period for maintaining exterior plantings in a healthy growing condition shall commence on the first day of exterior planting work under this contract and shall continue through the remaining life of the contract and end 12 months after the last day of exterior planting required by this contract. Written calendar time period shall be furnished for the plant establishment period. When there is more than one plant establishment period, the boundaries of the planted area covered for each period shall be described. The plant establishment period shall be coordinated with Sections 02921A SEEDING and 02922A SODDING. The plant establishment period shall be modified for inclement weather shut down periods, or for separate completion dates for areas.

3.9.2 Maintenance During Establishment Period

Maintenance of plant material shall include straightening plant material, straightening stakes; tightening guying material; correcting girdling; supplementing mulch; pruning dead or broken branch tips; maintaining plant material labels; watering; eradicating weeds, insects and disease; post-fertilization; and removing and replacing unhealthy plants.

3.9.2.1 Watering Plant Material

The plant material shall be watered as necessary to prevent desiccation and to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is estimated to be the equivalent of 25 mm absorbed water per week, delivered in the form of rain or augmented by watering. Run-off, puddling and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or existing plant material shall be prevented.

3.9.2.2 Weeding

Grass and weeds in the installed areas shall not be allowed to reach a maximum 75 mm height before being completely removed, including the root system.

3.9.2.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.9.2.4 Post-Fertilization

The plant material shall be topdressed at least once during the period of establishment with controlled release fertilizer, reference paragraph SOIL AMENDMENTS. Apply at the rate of 1 kilogram per 10 square meters of plant pit or bed area. Dry fertilizer adhering to plants shall be flushed off. The application shall be timed prior to the advent of winter dormancy.

3.9.2.5 Plant Pit Settling

When settling occurs to the backfill soil mixture, additional backfill soil shall be added to the plant pit or plant bed until the backfill level is equal to the surrounding grade. Serious settling that affects the setting of the plant in relation to the maximum depth at which it was grown requires replanting in accordance with paragraph INSTALLATION. The earth berm shall be maintained.

3.9.2.6 Maintenance Record

A record shall be furnished describing the maintenance work performed, the quantity of plant losses, diagnosis of the plant loss, and the quantity of replacements made on each site visit.

3.9.3 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. A shrub shall be considered unhealthy or dead when up to a maximum 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 2 mm square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for replacement. Unhealthy or dead plant material shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

3.9.4 Replacement Plant Material

Unless otherwise directed, plant material shall be provided for replacement in accordance with paragraph PLANT MATERIAL. Replacement plant material shall be installed in accordance with paragraph INSTALLATION, and recommendations in paragraph PLANT ESTABLISHMENT PERIOD. Plant material shall be replaced in accordance with paragraph WARRANTY. An extended plant establishment period shall not be required for replacement plant material.

3.9.5 Maintenance Instructions

Written instructions shall be furnished containing drawings and other necessary information for year-round care of the installed plant material; including, when and where maintenance should occur, and the procedures for plant material replacement.

-- End of Section --

SECTION 02935A

EXTERIOR PLANT MATERIAL MAINTENANCE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300	(1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4972	(1995a) pH of Soils

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Chemical Treatment Material; G, RE

Manufacturer's literature including physical characteristics, application and installation instructions for chemical treatment material.

Work Plan and Schedule; G, RE
Delivery Schedule; G, RE

Contractor's work plan and schedules.

Maintenance Record; G, RE

Contractor's record of each site visit.

Application of Pesticide; G, RE

Pesticide treatment plan with sequence of treatment work with

dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-06 Test Reports

Soil Tests; G, RE
Percolation Test; G, RE

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Fertilizer; G, RE
Mulch; G, RE
Pesticide; G, RE

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

a. Fertilizer. Chemical analysis and composition percent.

b. Mulch: Composition and source.

c. Pesticide. EPA registration number and registered uses.

1.3 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.3.1 Delivery Schedule

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.3.2 Delivery of Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.3.3 Storage

Materials shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.3.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS

2.1 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.1.1 NOT USED

2.1.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 55 percent shall pass through a 0.250 mm sieve. To raise soil pH, ground limestone shall be used.

2.1.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve and a minimum 97 percent shall pass through a 0.250 mm sieve.

2.1.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve and a minimum 35 percent shall pass through a 0.250 mm sieve.

2.1.2 NOT USED

2.1.3 Nitrogen Carrier Fertilizer

Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The nutrients ratio shall be 30 percent nitrogen, 30 percent phosphorus, and 30 percent potassium. The fertilizer may be a liquid nitrogen solution.

2.1.4 Organic Material

Organic material shall consist of decomposed wood derivatives.

2.1.4.1 NOT USED

2.1.4.2 NOT USED

2.1.4.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall consist of ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.2 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure shall not be used.

2.2.1 NOT USED

2.2.2 NOT USED

2.2.2.1 NOT USED

2.2.2.2 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

2.3 WATER

Water shall be the responsibility of the Contractor. Water shall not contain elements toxic to plant life.

2.4 PESTICIDE

Pesticide shall be an insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.5 HERBICIDE

Herbicide shall be EPA registered and approved; furnished for preemergence and postemergence application for crabgrass control and broad leaf weed control and complying with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification, and record keeping. Contractor shall keep records of all pesticide applications and forward data monthly to Contracting Officer. Record keeping format shall be submitted to Contracting Officer for approval.

PART 3 EXECUTION

3.1 SOIL TESTS

Contractor shall perform soil tests in accordance with ASTM D 4972.

3.2 SITE PREPARATION

3.2.1 NOT USED

3.2.2 Applying Fertilizer

Apply fertilizer at rate of 2 kilograms per square meter.

3.3 MULCHING

Mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.4 WATERING

Water to supplement rainfall shall be applied at a rate sufficient to ensure plant growth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.5 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.5.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control.

3.5.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended to prevent the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

3.6 GENERAL MAINTENANCE REQUIREMENTS

3.6.1 Fertilization

Fertilizer shall be applied at rate of 2 kilograms per square meter. Application shall be timed prior to the advent of winter dormancy and performed without burning plants.

3.6.2 Pesticide Treatment

Pesticide treatment for disease or pest shall be in accordance with

paragraph APPLICATION OF PESTICIDE.

3.6.3 NOT USED

3.6.4 Maintenance Record

A record of each site visit shall be furnished, describing:

a. Maintenance work performed.

b. Areas repaired or reinstalled.

c. Diagnosis for unsatisfactory stand of grass.

d. Diagnosis for unsatisfactory stand of plant material in planting bed.

e. Condition of trees.

f. Condition of shrubs.

g. Quantity and diagnosis of plant loss.

h. Irrigation of system.

3.7 GRASS PLANT QUALITY

Grass plants shall be evaluated for species and health when the grass plants are a minimum 25 mm high. The living grass area shall be maintained to be uniform in color and leaf texture; and free from weeds and other undesirable growth. The living grass area shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 25 mm in diameter, woody plant roots, and other materials detrimental to a healthy stand of grass plants. Broadleaf weeds and patches of foreign grasses shall be a maximum 2 percent of the total area.

3.7.1 Lawn Area

A satisfactory stand of grass plants for a lawn area shall be a minimum 200 grass plants per square meter . Bare spots shall be a maximum 150 mm square. The total bare spots shall be a maximum 2 percent of the total area.

3.7.2 Field Area

A satisfactory stand of grass plants for a field area shall be a minimum 100 grass plants per square meter . The total bare spots shall not exceed 2 percent of the total seeded area.

3.8 LAWN AND FIELD AREAS MAINTENANCE

3.8.1 Mowing

Lawn and field areas shall be mowed throughout the growing season to meet

the requirements of paragraph GRASS PLANT QUALITY. Cutting height shall be adjusted according to type of grass. Frequency of mowing shall be adjusted so that no more than 1/4 of leaf length is removed during a cutting.

3.8.1.1 Lawn Areas

Lawn areas shall be mowed to a minimum 100 mm height when the turf is a maximum 150 mm high. Remove clippings when the amount cut prevents sunlight from reaching the ground surface.

3.8.1.2 Field Areas

Field areas shall be mowed 6 times during the season to a minimum 300 mm height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.8.2 Turf Trimming

Turf adjoining paved areas, planting beds and trees shall be kept neatly trimmed at all times, essentially after each mowing. String trimmers at trees and shrubs will be allowed.

3.8.3 Aeration

Turf areas shall be aerated once per year using approved devices. Coring shall be performed by pulling soil plugs to minimum of 100 mm. Soil plugs produced in turf areas shall be left in place.

3.8.4 Lime

Lime for pH modification shall be applied as required to meet the requirements of paragraph GRASS PLANT QUALITY.

3.8.5 Herbicide Weed Control

Two or more applications of a pre-emergent herbicide and of a post-emergent herbicide shall be performed to meet the requirements of paragraph GRASS PLANT QUALITY.

3.8.6 Turf Fertilization Program

A regular program of fertilization shall be established to include a spring feeding and early summer feeding to meet the requirements of paragraph GRASS PLANT QUALITY. A total of four pounds of Nitrogen per 92 square meters shall be applied annually. Additional one pound Nitrogen applications shall be provided as grass color warrants.

3.9 PLANTING BEDS MAINTENANCE

3.9.1 Trimming

Spent flower heads shall be removed. Seasonal succession of bloom requires removal for new plant or trimming back bulb foliage.

3.9.2 Irrigation of Planting Beds

Run-off, puddling and wilting, watering of other adjacent areas or existing plant material shall be prevented.

3.9.3 Weed Control

Grass and weeds in planting beds shall be completely removed before reaching 75 mm in height.

3.10 PLANT MATERIAL QUALITY

3.10.1 General Requirements

Plant material shall be identified as native to the region of the site or as a specimen. Plant material shall be maintained as well shaped, well grown, vigorous plant material having healthy root systems. The plant material shall be maintained as free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems. Plant quality is determined by the growing conditions; climate and microclimate of the site for maintaining a healthy root system; and growth of the trunk and crown as follows.

3.10.2 Growth of Trunk and Crown

3.10.2.1 Deciduous Trees

Deciduous tree height to caliper relationship shall be maintained. Height of branching shall bear a relationship to the size and species of the tree and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

b. Multi-stem: To be considered a stem, there shall be no division of the trunk which branches more than 150 mm from ground level.

c. Specimen: The tree shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be indicated.

3.10.2.2 NOT USED

3.10.2.3 Deciduous Shrubs

Deciduous shrub height to number of primary stems shall be maintained. Shrubs shall be maintained as well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the site.

3.10.2.4 Coniferous Evergreen Plant Material

Coniferous evergreen plant material height-to-spread ratio shall be maintained. The coniferous evergreen trees shall not be "poled" or the leader removed. The plant material shall be maintained to be well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be indicated.

3.10.2.5 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material height-to-spread ratio shall be maintained. The plant material shall be shaped to be recognized by the trade as typical for the variety grown in the region of the site.

3.10.2.6 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall be maintained to have a heavy, well developed, and balanced crown with vigorous, well developed root system.

3.11 SHRUB AND HEDGE MAINTENANCE

3.11.1 Trimming and Pruning

Trimming shall be performed to ensure the following:

a. Safety.

b. Quality (size, height, and shape).

c. Health (removing broken, diseased branches).

d. Rejuvenation (removing one third to one half of the older stems or branches).

e. Visibility (signs, building entrances, motorist line of sight).

Shrubs shall be pruned to the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material or the theme shape of the hedge shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed.

3.11.2 Irrigation of Shrubs and Hedges

Run-off, puddling and wilting shall be prevented.

3.11.3 Shrub Fertilization Program

A regular program of fertilization shall be established to include a fall feeding to meet the requirements of paragraph PLANT MATERIAL QUALITY. Use industry standards for foliage and root fertilizing the plant material inventoried.

3.12 TREE MAINTENANCE

3.12.1 Trimming and Pruning of Trees

Trimming shall be performed to ensure the following:

a. Safety.

b. Quality (size, height).

c. Health (removing broken, diseased wood branches).

d. Rejuvenation (removing one third to one half of the older stems or branches).

e. Visibility (signs, building entrances, motorist line of sight).

Trees shall be pruned to meet the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

3.12.2 Irrigation of Trees

Run-off, puddling and wilting shall be prevented.

3.12.3 Tree Fertilization Program

A regular program of fertilization shall be established to include a fall feeding to meet the requirements of paragraph PLANT MATERIAL QUALITY. Use industry standards for foliage and root fertilizing the plant material inventoried.

3.12.4 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. A shrub shall be considered unhealthy or dead when up to a maximum 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 2 mm square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall provide recommendations for replacement. Unhealthy or dead plant material shall be removed immediately.

3.13 RESTORATION AND CLEAN UP

3.13.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the maintenance operations shall be restored to original condition at Contractor's expense.

3.13.2 Clean Up

Excess and waste material shall be removed from the maintenance areas and dispose off site. Adjacent paved areas shall be cleaned as determined by the Contracting Officer.

3.14 CLEANING OF PAVED AREAS

Grass, weeds, leaves, and debris from mowing, clipping, and pruning shall be removed immediately. Excess and waste material shall be removed from paved areas and disposed off site. Debris, leaves shall be removed monthly.

-- End of Section --

SECTION 03100A

STRUCTURAL CONCRETE FORMWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 347R	(1994) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard

U.S. DEPARTMENT OF COMMERCE (DOC)

PS-1	(1996) Voluntary Product Standard - Construction and Industrial Plywood

1.2 NOT USED

1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

1.4 STORAGE AND HANDLING

Fiber voids shall be stored above ground level in a dry location. Fiber voids shall be kept dry until installed and overlaid with concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

2.1.1 Forms For Class B Finish

Forms for Class B finished surfaces shall be plywood panels conforming to

PS-1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to PS-1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 Retain-In-Place Metal Forms

Retain-in-place metal forms for concrete slabs and roofs shall be as specified in Section 05300 STEEL DECKING.

2.1.5 NOT USED

2.1.6 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6 mm nor more than 25 mm deep and not more than 25 mm in diameter. Removable tie rods shall be not more than 38 mm in diameter.

2.1.7 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to

have a Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb: In any 3 m of length -------- 6 mm

TABLE 1

TOLERANCES FOR FORMED SURFACES

a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length -- 25 mm
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 6 m of length -------- 6 mm Maximum for entire length 13 mm
2. Variation from the level or from the grades indicated on the drawings:	In any 3 m of length ------- 6 mm In any bay or in any 6 m of length ---------- 10 mm
a. In exposed lintels, sills,parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 6 m of length ---------- 6 mm Maximum for entire length - 13 mm
3. Variation of the linear building lines from established position in plan	In any 6 m ---------- 13 mm Maximum ---------- 25 mm
4. Variation of distance between walls, columns, partitions	6 mm per 3 m of distance, but not more than 13 mm in any one bay, and not more than 25 mm total variation
5. Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ---------- 6 mm Plus ---------- 13 mm
6. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ---------- 6 mm Plus ---------- 13 mm
7. Footings:	
a. Variation of dimensions in plan	Minus ---------- 13 mm Plus ---------- 50 mm when formed or plus 75 mm when

TABLE 1

TOLERANCES FOR FORMED SURFACES

	placed against unformed excavation
b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than --------- 50 mm
c. Reduction in thickness	Minus ---------- 5 percent of specified thickness
8. Variation in steps:	Riser ---------- 3 mm
a. In a flight of stairs	Tread ---------- 6 mm
b. In consecutive steps	Riser ---------- 2 mm Tread ---------- 3 mm

-- End of Section --

SECTION 03150A

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 919	(1984; R 1998) Use of Sealants in Acoustical Applications
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 471	(1998el) Rubber Property - Effect of Liquids
ASTM D 1190	(1997) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1191	(1984; R 1994el)

Concrete Joint Sealers

ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 5249	(1995) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Preformed Expansion Joint Filler
Sealant
Waterstops

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops.

Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 3 mm (1/8 inch) thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 10 mm (3/8 inch) thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 NOT USED

2.3.2 NOT USED

2.3.3 Hot-Poured Type

ASTM D 1190 tested in accordance with ASTM D 1191.

2.3.4 Field-Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

2.4.1 NOT USED

2.4.2 NOT USED

2.4.3 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471.

2.4.4 NOT USED

2.4.5 Preformed Elastic Adhesive

Preformed plastic adhesive waterstops shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, asbestos, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 3 mm wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 25 mm .

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth,

unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 3 mm (1/8 inch) radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.1.3.1 NOT USED

3.1.3.2 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 4 degrees C . When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 NOT USED

3.2.2 NOT USED

3.2.3 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile

dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

3.2.3.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.3.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.3.3 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 2 mm . 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 2 mm or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 13 mm in 3 m. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.4 NOT USED

3.2.5 Preformed Plastic Adhesive Installation

The installation of preformed plastic adhesive waterstops shall be a prime, peel, place and pour procedure. Joint surfaces shall be clean and dry before priming and just prior to placing the sealing strips. The end of each strip shall be spliced to the next strip with a 25 mm overlap; the overlap shall be pressed firmly to release trapped air. During damp or cold conditions the joint surface shall be flashed with a safe, direct flame to warm and dry the surface adequately; the sealing strips shall be dipped in warm water to soften the material to achieve maximum bond to the concrete surface.

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300 CAST-IN-PLACE STRUCTURAL

CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

-- End of Section --

SECTION 03200A

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M/318RM	(1999) Building Code Requirements for Structural Concrete and Commentary (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995e1) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(1998) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1	(1996) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office

that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement; G, RE

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-07 Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 NOT USED

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100 by 100 mm when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 13 mm of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318M/318RM . Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M/318RM at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M/318RM . If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to AACI 318M/318RM and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. Mechanical butt splices

shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 50 mm. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 1.2 m. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

-- End of Section --

SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 214.3R	(1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 1996) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory

	Evaluation
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1994ael) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2000e1) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999ae1) Concrete Aggregates
ASTM C 330	(2000) Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2001) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 567	(2000) Unit Weight of Structural Lightweight Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)

ASTM C 618	(2000) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM E 96	(2000) Water Vapor Transmission of Materials

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards \n/c\X
NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.2 NOT USED

1.3 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G, RE

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

Lightweight Aggregate Concrete; G, RE

Written recommendations from lightweight aggregate supplier on batching and mixing cycles.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G, RE

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

1.5 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
Concrete Laboratory Testing Technician, Grade I or II
Concrete Construction Inspector, Level II

Concrete Transportation Construction Inspector or
Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.6 NOT USED

1.7 NOT USED

1.8 GENERAL REQUIREMENTS

1.8.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.8.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
Conventional Bullfloated	Same

Floor Profile Quality Classification From ACI 117/117R	This Section
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.8.1.2 NOT USED

1.8.1.3 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 3 m straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Float Finish 5 mm
Trowel Finish 3 mm

1.8.2 Strength Requirements and w/c Ratio

1.8.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
27.5 MPa at 28 days	All concrete surfaces except as noted

Concrete slabs on-grade shall have a 28-day flexural strength of 4.5 MPa. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39/C 39M.

a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (152 by 305 mm cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is

considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

1.8.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.45	All concrete except as noted

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.8.3 Air Entrainment

Except as otherwise specified, all normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 19 mm or smaller it shall be between 4.5 and 7.5 percent. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231. Lightweight concrete in the 2nd story of the training building shall not be air-entrained.

1.8.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump Minimum	Slump Maximum
Walls, columns and beams	50 mm	100 mm
Foundation walls, substructure walls, footings, slabs	25 mm	75 mm
Any structural concrete approved for placement by pumping:		
At pump	50 mm	150 mm
At discharge of line	25 mm	100 mm

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 50 to 100 mm before the admixture is added and a maximum slump of 200 mm at the point of delivery after the admixture is added. For troweled floors, slump of structural lightweight concrete with normal weight sand placed by pump shall not exceed 125 mm at the point of placement. For other slabs, slump of lightweight concrete shall not exceed 100 mm at point of placement.

1.8.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 32 degrees C. When the ambient temperature during placing is 5 degrees C or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 12 and 25 degrees C.

1.8.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following:

three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.8.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.8.8 Lightweight Aggregate Structural Concrete

Lightweight aggregate structural concrete shall conform to the requirements specified for normal weight concrete except as specified herein. Specified compressive strength shall be at least 27.5 MPa at 28 days, as determined by test specimens that have been air dried at 50 percent relative humidity for the last 21 days. Air-dry unit weight shall be not over 1850 kg/cubic meter at 28 days as determined by ASTM C 567. However, fresh unit weight shall be used for acceptance during concreting, using a correlation factor between the two types of unit weight as determined during mixture design studies.

1.8.9 Technical Service for Specialized Concrete

The services of a factory trained technical representative shall be obtained to oversee proportioning, batching, mixing, placing, consolidating, and finishing of specialized structural concrete, such as lightweight concrete. The technical representative shall be on the job full time until the Contracting Officer is satisfied that field controls indicate concrete of specified quality is furnished and that the Contractor's crews are capable of continued satisfactory work. The technical representative shall be available for consultation with, and advice to, Government forces.

1.9 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.9.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air

content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance withASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39/C 39M. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.9.2 NOT USED

1.9.3 Proportioning Studies for Lightweight Aggregate Structural Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except as follows. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.2, using at least three different cement contents. Trial mixes shall be proportioned to produce air dry unit weight and concrete strengths specified in paragraph GENERAL REQUIREMENTS. Trial mixtures shall be proportioned for maximum permitted slump and air content. Test specimens and testing shall be as specified for normal weight concrete except that 28-day compressive strength shall be determined from test cylinders that have been air dried at 50 percent relative humidity for the last 21 days. Air dry unit weight shall be determined in accordance with ASTM C 567 and shall be designed to be at least 32 kg per cubic meter less than the maximum specified air dry unit weight in paragraph GENERAL REQUIREMENTS. Curves shall be plotted using these results showing the relationship between cement factor and

strength and air dry unit weight. Normal weight fine aggregate may be substituted for part or all of the lightweight fine aggregate, provided the concrete meets the strength and unit weight. A correlation shall also be developed showing the ratio between air dry unit weight and fresh concrete unit weight for each mix.

1.9.4 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, the mixture shall be adjusted, as approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.9.4.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 7 MPa of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

f'cr = f'c + 1.34S where units are in MPa

f'cr = f'c + 2.33S - 3.45 where units are in MPa

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION

1.9.4.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

a. If the specified compressive strength f'c is less than 20 MPa,

f'cr = f'c + 6.9 MPa

b. If the specified compressive strength f'c is 20 to 35 MPa,

f'cr = f'c + 8.3 MPa

c. If the specified compressive strength f'c is over 35 MPa,

f'cr = f'c + 9.7 MPa

1.10 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.11 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.11.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative

test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.11.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.11.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.11.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, portland-pozzolan cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I with a maximum 15 percent amount of tricalcium aluminate, or Type II.

2.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III with tricalcium aluminate limited to 8 percent. Type III cement shall be used only in isolated instances and only when approved in writing.

2.1.3 Blended Cements

ASTM C 595M , Type IP.

2.1.4 Pozzolan (Fly Ash)

ASTM C 618, Class C with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by

weight of the total cementitious material.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size designation 67.

2.2.3 Lightweight Aggregate

Lightweight fine and coarse aggregate shall conform to the quality and gradation requirements of ASTM C 330, size 67 for coarse aggregate. Lightweight aggregate shall be prewetted in accordance with the Manufacturer's instructions unless otherwise specified. For pumped concrete, prewetting shall be sufficient to ensure that slump loss through the pump line does not exceed 100 mm.

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.3.5 NOT USED

2.3.6 NOT USED

2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade A, and shall be a commercial formulation suitable for the proposed application.

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the

application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09510 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.11 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

2.12 PERIMETER INSULATION AND UNDER SLAB INSULATION (OMS)

Perimeter insulation shall be cellular glass conforming to ASTM C 552, Type IV, Grade 2.

2.13 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 0.15 mm (6 mils) or other equivalent material having a vapor permeance rating not exceeding 30 nanograms per Pascal per second per square meter (0.5 perms) as determined in accordance with ASTM E 96.

2.14 JOINT MATERIALS

2.14.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751. Materials for waterstops shall be in accordance with Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section 07900 JOINT SEALING.

2.14.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use,

clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Rock surfaces shall be kept continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Concrete shall be placed before the mortar stiffens.

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02315EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 NOT USED

3.1.2.1 NOT USED

3.1.2.2 NOT USED

3.1.2.3 NOT USED

3.1.2.4 NOT USED

3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 300 mm. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 300 mm. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 50 mm wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. A 50 mm layer of compacted, clean concrete sand (fine aggregate) shall be placed on top of the vapor barrier before placing concrete. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering sand.

3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 300 mm of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating

transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall conform to the following subparagraphs.

3.2.1.1 General

The batching plant shall be located off site close to the project. The batching, mixing and placing system shall have a capacity of at least 50 cubic meters per hour. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. When use of truck mixers makes this requirement impractical, the admixture dispensers shall be interlocked with the sand batchers. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a

permanent sign stating the contents.

3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.1.4 Batching Tolerances

(A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the

mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.3 NOT USED

3.4 LIGHTWEIGHT AGGREGATE CONCRETE

In addition to the requirements specified for normal weight concrete, lightweight aggregate concrete shall conform to the following. The batching and mixing cycle shall be as directed based on written recommendations from the aggregate supplier which the Contractor shall furnish. Unless otherwise directed, the mixer shall be charged with approximately 2/3 of the total mixing water and all of the aggregate. This shall be mixed for at least 1-1/2 minutes in a stationary mixer or 15 revolutions at mixing speed in a truck mixer. The remaining ingredients shall then be added and mixing continued as specified for normal weight concrete. Lightweight aggregate concrete shall not be vibrated to the extent that large particles of aggregate float to the surface. During finishing, lightweight aggregate concrete shall not be worked to the extent that mortar is driven down and lightweight coarse aggregate appears at the surface. Lightweight aggregate concrete to be pumped shall have a cement content of at least 335 kg per cubic meter.

3.5 NOT USED

3.6 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers. Nonagitating equipment, other than pumps, shall not be used for transporting lightweight aggregate concrete.

3.7 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.7.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 0.2 square meters.The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 1.5 cubic meters shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.7.2 NOT USED

3.7.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.7.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.7.5 NOT USED

3.7.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 100 mm. Aluminum pipe shall not be used.

3.8 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.8.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 300 mm thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

3.8.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 100 mm thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.6 mm, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while

operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 100 mm and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segration or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.8.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 5 degrees C. The temperature of the concrete when placed shall be not less than 10 degrees C nor more than 25 degrees C. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.8.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 30 degrees C, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 49 degrees C. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	33 C
40-60	30 C
Less than 40	27 C

3.8.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.9 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 50 mm clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 1.5 kg per square meter asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07900 JOINT SEALING.

3.9.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 15 meters. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the

concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 25 mm square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25 mm above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.9.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations or sawing a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 3 and 5 mm wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.9.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07900 JOINT SEALING.

3.9.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.9.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1 mm in 100 mm. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.10 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.10.1 Class B Finish

Class B finish is required in the following areas, inside surfaces of arms vault. Fins, ravelings, and loose material shall be removed, all surface defects over 12 mm in diameter or more than 12 mm deep, shall be repaired and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained.

3.10.2 Class C Finish

Class C finish is required in areas not otherwise indicated. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm deep or more than 50 mm in diameter shall be repaired. Defects more than 50 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep.

3.11 REPAIRS

3.11.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 100 mm shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.11.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm deep or, for Class B finishes, more than 12 mm in diameter and, for Class C finishes, more than 50 mm in diameter. Also included are any defects of any kind whose depth is over 100 mm or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.11.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 50 mm on all sides. All such defective areas greater than 7800 square mm shall be outlined by saw cuts at least 25 mm deep. Defective areas less than 7800 square mm shall be outlined by a 25 mm deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before

completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.11.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 150 mm deep and also have an average diameter at the surface more than 450 mm or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.12 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.12.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 10 degrees C. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be

met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.12.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.12.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The following areas top of arms vault shall be given only a float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 6 mm and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.12.4 Troweled Finish

All interior floor slabs shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 3 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.13 FLOOR HARDENER

The following areas, all mechanical rooms, and the OMS workbay, shall be treated with floor hardener. Floor hardener shall be applied after the concrete has been cured and then air dried for 14 days. Three coats shall be applied, each the day after the preceding coat was applied. For the first application, 0.5 kg of the silocofluoride shall be dissolved in 4 liters of water. For subsequent applications, the solution shall be 1.0 kg of silicofluoride to each 4 liters of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted salts. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

3.14 EXTERIOR SLAB AND RELATED ITEMS

3.14.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation

shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 3.75 m in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 1 m longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 3.75 straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 1.0 to 1.5 m wide and 0.7 m longer than the pavement width shall be carefully pulled across the surface. Edges and joints shall be rounded with an edger having a radius of 3 mm. Curing shall be as specified.

3.14.2 Sidewalks

Concrete shall be 100 mm minimum thickness. Contraction joints shall be provided at 1.75 m spaces unless otherwise indicated. Contraction joints shall be cut 25 mm deep with a jointing tool after the surface has been finished. Transverse expansion joints 12 mm thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1 mm per 50 mm shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1 mm per 250 mm.

3.14.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 75 mm deep with a jointing tool after the surface has been finished. Expansion joints (12 mm wide) shall be provided at 35 m maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.14.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.15 CURING AND PROTECTION

3.15.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 10 degrees C for the first 3 days and at a temperature above 0 degrees C for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.15.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.15.3 Membrane Forming Curing Compounds

Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements, may be used for surfaces which are to be painted or are to receive bituminous roofing or

waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 500 kPa, at a uniform coverage of not more than 10 cubic meters per L for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.15.4 Impervious Sheeting

Concrete surfaces may be cured using impervious sheets at Contractor's option with Contracting Officer's approval. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 450 mm wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 300 mm and securely weighted down or shall be lapped not less than 100 mm and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.15.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete.

3.15.6 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 0 degrees C the temperature of the concrete shall be maintained above 5 degrees C for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature

differential of more than 13 degrees C as determined by suitable temperature measuring devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 50 mm inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.16 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 20 mm. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Nonshrink grout shall be used for column base plates.

3.16.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.16.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.16.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 18 to 30 degrees C until after setting.

3.16.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.17 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077.

3.17.1 Grading and Corrective Action

3.17.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.17.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall

be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.17.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.17.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.17.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter for each class of concrete batched during each day's plant operation.

3.17.5 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when

excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government

inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 12.5 mm below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 50 mm. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 380 cubic meters or portion thereof of that concrete mixture placed

each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.17.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.17.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.17.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip

and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.17.9 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square meters per Liter, and shall note whether or not coverage is uniform.

d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.17.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.17.11 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 60,000 cubic meters of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall

be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.17.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

SECTION 03413A

PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI SP-66	(1994) ACI Detailing Manual: Section Details and Detailing of Concrete Reinforcement
ACI 318M	(1995) Metric Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 416/A 416M	(1997) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM C 494	(1998) Chemical Admixtures for Concrete
ASTM C 1017	(1997) Chemical Admixtures for Use in Producing Flowing Concrete

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structured Welding Code - Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
PCI MNL-117	(1996) Manual for Quality Control for

Plants and Production of Architectural Precast Concrete Products

PCI MNL-122 (1989) Architectural Precast Concrete

1.2 GENERAL REQUIREMENTS

Precast concrete units shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer certified under the PCI Plant Certification Program. The manufacturer shall have been regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings for at least 3 years. Precast work shall be coordinated with the work of other trades.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Architectural Concrete System; G, RE

Detail drawings showing details in accordance with ACI SP-66 and ACI 318M , including installation details. Detail drawings shall indicate separate identification marks for each different precast unit, location of units in the work, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, blocking points for units stored at the precast concrete plant or at the jobsite, lifting points and special handling instructions in sufficient detail to cover manufacture, handling, and erection.

SD-03 Product Data

Calculations; G, RE

Design calculations, prior to the manufacture of any precast architectural concrete units for the project.

Mix Design; G, RE

A statement giving the maximum nominal coarse aggregate size, the proportions of all ingredients and the type and amount of any admixtures that will be used in the manufacture of each strength and type of concrete, prior to commencing operations. The statement shall be accompanied by test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made without additional tests to verify that the concrete properties are satisfactory.

Manufacturer's Qualifications; G, RE

A statement giving the qualifications of the precast concrete manufacturer and of the installers, prior to commencing operations.

SD-04 Samples

Precast Concrete Units; G, RE

Two 300 by 300 by 50 mm samples of each type of precast unit finish required for the project. Samples shall show matrix color, surface color, surface texture, and panel back finish. A full-size mock-up, maintained at the precast concrete manufacturer's plant until approval by the Contracting Officer for removal or incorporating in the project. The mock-up shall be used to establish quality and acceptance of precast units to be used on the project, and shall consist of three or more units, showing the exterior finish (matrix color, surface color, surface texture), panel back finish, edge treatment, joint treatment, reinforcement, anchorage insert, lifting inserts, and other accessories. Mockup shall also include typical joints, including exterior corner joints and joints between units.

SD-06 Test Reports

Materials; G, RE

Certified copies of test reports including all test data and all test results. Tests for compressive strength of concrete shall be performed by an approved independent commercial testing laboratory, except that compressive strength tests for initial prestress may be performed in the manufacturer's plant laboratory.

1.4 DESIGN

1.4.1 Standards and Loads

Precast unit design shall conform to ACI 318M and PCI MNL-122. Design loads for precast concrete shall be as indicated on the drawings. A differential temperature of 89 degrees C, between interior and exterior faces of the units, shall be considered in the design. Stresses due to restrained volume change caused by shrinkage and temperature differential, handling, transportation and erection shall be accounted for in the design.

1.4.2 Connections

Connection of units to other members, or to other units shall be of the type and configuration indicated. The design and sizing of connections for all design loads shall be by the Contractor.

1.4.3 Concrete Strength

Precast concrete units shall have a 28-day compressive strength of 34 MPa .

1.4.4 Concrete Proportion

Selection of proportions for concrete shall be based on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. The concrete proportion shall be developed using the same type and brand of cement, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Calcium chloride shall not be used in precast concrete and admixtures containing chloride ions, nitrates, or other substances that are corrosive shall not be used in prestressed concrete.

1.4.5 Calculations

Calculations for design of members and connections not shown shall be made by a professional engineer experienced in the design of precast architectural concrete. Calculation shall include the analysis of member for lifting stresses and the sizing of the lifting inserts.

1.5 STORAGE AND INSPECTION AT MANUFACTURER'S PLANT

Precast units temporarily stored at the manufacturer's plant shall be protected from damage in accordance with PCI MNL-117 and PCI MNL-122. Immediately prior to shipment to the jobsite, all precast concrete units shall be inspected for quality to insure all precast units conform to the requirements specified. Inspection for quality shall include, but shall not necessarily be limited to, the following elements: color, texture, dimensional tolerances, chipping, cracking, staining, warping and honeycombing. All defective precast concrete units shall be replaced or repaired as approved.

1.6 HANDLING AND STORAGE

Precast units shall be delivered to the site in accordance with delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite all precast units shall be inspected for quality as specified above. If the precast units cannot be unloaded and placed directly into the work, they shall be stored onsite, off the ground and protected from weather, marring, or overload. Precast units shall be handled in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

Except as otherwise specified, material shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and Section 03200 CONCRETE REINFORCEMENT.

2.1.1 NOT USED

2.1.2 Reinforcing Steel

Reinforcing steel shall be galvanized if clearance to an exterior face is

25 mm or less.

2.1.3 Prestressing Strands

Prestressing strands shall conform to ASTM A 416/A 416M.

2.1.4 Tie Wire

Tie wire shall be soft monel or 18-8 stainless steel.

2.1.5 Inserts

Inserts shall be manufacturer's standard, suited for the application.

2.1.6 Plates, Angles, Anchors and Embedments

Material shall be as specified in PCI MNL-117. Steel items, other than stainless, shall be coated with a rust-inhibiting paint or shall be hot-dip galvanized. Steel items, including items embedded in concrete, shall be either stainless steel or hot dip galvanized steel.

2.1.7 Form Release Agent

Release agent shall be manufacturer's standard nonstaining type.

2.1.8 Admixtures

Admixtures shall conform to ASTM C 494. Plasticizing admixture, if used, shall conform to ASTM C 1017.

2.2 PRECAST CONCRETE UNITS

Precast concrete units shall be manufactured and cured in accordance with the applicable provisions of PCI MNL-116 and PCI MNL-117. Units shall be manufactured within the allowable tolerances given in PCI MNL-117 and PCI MNL-122.

2.2.1 Formwork

Forms shall be steel of adequate thickness, braced, stiffened, anchored and aligned to produce precast architectural concrete units within required dimensional tolerances. Forms shall be sufficiently rigid to provide dimensional stability during handling and concrete placement and consolidation. Fiberglass-reinforced plastic, plastic coated wood, elastomeric or other nonabsorptive material shall be used for making tight joints and rustication pieces.

2.2.2 Reinforcement

Fabrication and placement of reinforcement shall conform to the details shown on the approved detail drawings and PCI MNL-117.

2.2.3 Embedded Accessories

Anchors, inserts, lifting devices, and other accessories which are to be embedded in the precast units shall be furnished and installed in accordance with the approved detail drawings. Embedded items shall be accurately positioned in their designed location, and shall have sufficient anchorage and embedment to satisfy design requirements.

2.2.4 Stripping

Precast concrete units shall not be removed from forms until units develop sufficient strength to safely strip the formwork and to remove the precast concrete units from the forms to prevent damage to the units from overstress or chipping.

2.2.5 Identification

Each precast concrete unit shall be marked to correspond to the identification marks for each different precast unit shown on the detail drawings.

2.2.6 Finishes

2.2.6.1 Exposed Surfaces

Surfaces of precast units exposed to view or surfaces indicated to be finished shall be finished as follows:

Mechanically Textured Finishes: Sandblasted.

Concrete Finishes: Light-Provide a 0 to 2 mm reveal of course aggregate and uniform color.

2.2.6.2 Other Surfaces

Surfaces of precast units not exposed to view or not otherwise indicated to be finished shall be finished in accordance with Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

PART 3 EXECUTION

3.1 ERECTION

Precast units shall be erected in accordance with the detail drawings and without damage to other units or to adjacent members. Units shall be set true to alignment and level, with joints properly spaced and aligned both vertically and horizontally. Erection tolerances shall be in accordance with the requirements of PCI MNL-117 and PCI MNL-122. As units are being erected, shims and wedges shall be placed as required to maintain correct alignment. After final attachment, precast units shall be grouted as shown. After erection, welds and abraded surfaces of steel shall be cleaned and touched-up with a zinc-rich paint. Welds shall be made by a certified welder in accordance with the manufacturer's erection drawings. Pickup points, boxouts, inserts, and similar items shall be finished to match adjacent areas after erection. Erection of precast units shall be supervised and performed by workmen skilled in this type of work. Welding

and the qualifications of welders shall be in accordance with AWS D1.1.

3.2 JOINT SEALING

Joint sealing shall be as specified in Section 07900 JOINT SEALING.

3.3 CLEANING

Not sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast concrete discolored during erection shall be cleaned to remove dirt and stains by dry scrubbing with a stiff fiber brush, wetting the surface and vigorous scrubbing of the finish with a stiff fiber brush followed by additional washing, or by chemical cleaning compounds such as detergents or other commercial cleaners. Commercial cleaners shall be used in accordance with the manufacturer's recommendations. Cleaning procedure shall be performed on a designated test area and shall be approved prior to proceeding with cleaning work. Discolorations which cannot be removed by these procedures, will be considered defective work. Cleaning work shall be done when temperature and humidity permit surfaces to dry rapidly. Adjacent surfaces shall not be damaged during cleaning operations.

3.4 PROTECTION OF WORK

Precast units shall be protected against damage from subsequent operations.

3.5 DEFECTIVE WORK

Precast concrete units damaged during erection shall be repaired as soon after occurrence as possible or replaced, as directed, using approved procedures. All repairs to precast concrete units shall match the adjacent surfaces in color and texture and shall be as approved. Unless otherwise approved, repair procedures shall conform to PCI MNL-117.

-- End of Section --

SECTION 04200A

MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI SP-66	(1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 67	(2000) Sampling and Testing Brick and Structural Clay Tile
ASTM C 90	(2000) Loadbearing Concrete Masonry Units
ASTM C 140	(1999b) Sampling and Testing Concrete Masonry Units
ASTM C 216	(2000) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(2000) Mortar for Unit Masonry
ASTM C 476	(1999) Grout for Masonry
ASTM C 494/C 494M	(1999a) Chemical Admixtures for Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 641	(1982; R 1998el) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(2000a) Hollow Brick (Hollow Masonry Units

	Made From Clay or Shale)
ASTM C 744	(1999) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(2000) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 1019	(2000) Sampling and Testing Grout
ASTM C 1072	(2000) Measurement of Masonry Flexural Bond Strength
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2240	(2000) Rubber Property - Durometer Hardness
ASTM D 2287	(1996a) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 447	(1997) Compressive Strength of Masonry Prisms

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Masonry Work; G, RE

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. Drawings shall be provided showing the location and layout of glass block units. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the

Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Clay or Shale Brick; G, RE
Prefaced Concrete Masonry Units; G, RE
Insulation; G, RE
Ground Face Concrete Masonry Units; G, RE

Manufacturer's descriptive data.

Cold Weather Installation; G, RE

Cold weather construction procedures.

SD-04 Samples

Ground Face Concrete Masonry Units (CMU); G, RE
Concrete Masonry Units (CMU); G, RE
Prefaced Concrete Masonry Units; G, RE
Clay or Shale Brick; G, RE

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture.

Anchors, Ties, and Bar Positioners; G, RE

Two of each type used.

Expansion-Joint Material; G, RE

One piece of each type used.

Joint Reinforcement; G, RE

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation; G, RE

One piece of board type insulation, not less than 400 by 600 mm in size, containing the label indicating the rated permeance and R-values.

Portable Panel; G, RE

One panel of clay or shale brick, 600 by 600 mm, containing approximately 24 brick facings to establish range of color and texture.

SD-06 Test Reports

Efflorescence Test; G, RE
Field Testing of Mortar; G, RE
Field Testing of Grout; G, RE
Prism tests; G, RE
Masonry Cement; G, RE
Fire-rated CMU; G, RE

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; G, RE

Copies of masonry inspector reports.

SD-07 Certificates

Clay or Shale Brick; G, RE
Concrete Masonry Units (CMU); G, RE
Prefaced Concrete Masonry Units; G, RE
Control Joint Keys; G, RE
Anchors, Ties, and Bar Positioners; G, RE
Expansion-Joint Materials; G, RE
Joint Reinforcement; G, RE
Reinforcing Steel Bars and Rods; G, RE
Masonry Cement; G, RE
Mortar Coloring; G, RE
Insulation; G, RE
Precast Concrete Items; G, RE
Mortar Admixtures; G, RE
Grout Admixtures; G, RE
Ground Face Concrete Masonry Units; G, RE

Certificates of compliance stating that the materials meet the specified requirements.

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 2.5 m long by 1.8 m high.

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, glass block units, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 600 by 600 mm opening placed at least 600 mm above the panel base and 600 mm away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather. In addition, glass block units and prefaced concrete units shall be stored with their finish surfaces covered. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.5 SPECIAL INSPECTION

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. The Contractor has the option to use

either hard metric or substitute inch-pound (soft-metric) CMU products. If the Contractor decides to substitute inch-pound CMU products, the following additional requirements shall be met:

a. The metric dimensions indicated on the drawings shall not be altered to accommodate inch-pound CMU products either horizontally or vertically. The 100 mm building module shall be maintained, except for the CMU products themselves.

b. Mortar joint widths shall be maintained as specified.

c. Rebars shall not be cut, bent or eliminated to fit into the inch-pound CMU products module.

d. Brick and inch-pound CMU products shall not be reduced in size by more than one-third (1/3) in height and one-half (1/2) in length. Cut CMU products shall not be located at ends of walls, corners, and other openings.

e. Cut, exposed brick and CMU products shall be held to a minimum and located where they would have the least impact on the architectural aesthetic goals of the facility.

f. Other building components, built into the CMU products, such as window frames, door frames, louvers, grilles, fire dampers, etc., that are required to be metric, shall remain metric.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Grade SW shall be used for brick in contact with earth or grade and for the first six exterior courses above grade. Grade SW or MW shall be used in other brickwork. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 216, Type FBS. Brick size shall be modular and the nominal size of the brick used shall be 92 mm thick, 57 mm wide, and 194 mm long. Minimum compressive strength of the brick shall be 15.2 MPa.

2.2.2 Hollow Clay or Shale Brick

Hollow clay or shale brick shall conform to ASTM C 652, Type HBS. Brick size shall be modular and the nominal size of the brick used shall be 92 mm thick, 57 mm wide, and 194 mm long. Where vertical reinforcement is shown in hollow brick, the minimum cell dimension shall be 64 mm (2-1/2 inches) and the units shall be designed to provide precise vertical alignment of the cells. Minimum compressive strength of the brick shall be 15.2 MPa.

2.2.3 Structural Hollow Clay or Shale Brick

Structural hollow clay or shale brick shall conform to ASTM C 216, type FBX. Brick size shall be modular and the nominal size of the brick used shall be 200 mm thick, 100 mm wide, 400 mm long. Where vertical reinforcement is shown in hollow brick, the minimum cell dimension shall be designed to provide precise vertical alignment of the cells. Minimum compressive strength of the brick shall be 55 MPa.

2.3 NOT USED

2.4 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90. Cement shall have a low alkali content and be of one brand.

2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 25 mm . Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4.2.1 Architectural Units

Units shall have ground face shell. Units shall be integrally colored during manufacture. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.4.3 Fire-Rated CMU

Concrete masonry units used in fire-rated construction shown on the drawings shall be of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating.

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

Aggregate Type	Minimum equivalent thickness in mm (inches) for fire rating of: 4 hours	3 hours	2 hours
Pumice	120 (4.7)	100 (4.0)	75 (3.0)
Expanded slag	130 (5.0)	110 (4.2)	85 (3.3)
Expanded clay, shale, or slate	145 (5.7)	120 (4.8)	95 (3.7)
Limestone, scoria, cinders or unexpanded slag	150 (5.9)	130 (5.0)	100 (4.0)
Calcareous gravel	160 (6.2)	135 (5.3)	105 (4.2)
Siliceous gravel	170 (6.7)	145 (5.7)	115 (4.5)

(a) Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in millimeters . Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

2.5 PREFACED CONCRETE MASONRY UNITS

Prefaced concrete masonry units shall conform to ASTM C 744 using masonry units conforming to ASTM C 90. The facing shall turn over the edges and ends of the unit at least 10 mm (3/8 inch) in the direction of the thickness of the unit to form a lip at least 2 mm (1/16 inch) thick. Variation in color and texture shall not exceed that of the approved samples. All shapes and sizes shall be provided for a complete installation. Bullnose units shall be used along sills and caps and at vertical external corners including door jambs, window jambs, and other such openings. Radius of the bullnose shall be 25 mm (1 inch) . Base units shall be coved to meet finished floor surfaces where ceramic tile floor occurs.

2.6 NOT USED

2.7 NOT USED

2.8 PRECAST CONCRETE ITEMS

Splashblocks shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 28 MPa (4000 psi) minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 13 mm (1/2 inch) to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 20 mm shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 827 kPa (120 psi) for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 35 kg shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.8.1 NOT USED

2.8.2 NOT USED

2.8.3 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.9 NOT USED

2.10 MORTAR

Mortar shall be Type S in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Masonry cement shall not be used for concrete masonry construction. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the 2.36 mm sieve and 95 percent passing the 1.18 mm sieve. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.10.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.10.2 Coloring

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color matching Brixment, Light Chocolate E-131. Mortar coloring shall not exceed 3 percent of the weight of cement for carbon black and ten percent of the weight of cement for all other pigments. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement.

2.11 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and 250 mm. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.11.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.11.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.12 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 16 mm mortar cover from either face.

2.12.1 Wire Mesh Ties

Wire mesh for tying 100 mm thick concrete masonry unit partitions to other intersecting masonry partitions shall be 13 mm mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 300 mm .

2.12.2 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 5 mm diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 100 mm wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 5 mm diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 13 mm eccentricity

between each element of the tie. Play between pintle and eye opening shall be not more than 2 mm (1/16 inch) . The pintle and eye elements shall be formed so that both can be in the same plane.

2.12.3 NOT USED

2.12.4 Adjustable Anchors

Adjustable anchors shall be 5 mm diameter steel wire, triangular-shaped. Anchors attached to steel shall be 8 mm diameter steel bars placed to provide 2 mm (1/16 inch) play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.12.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.13 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 16 mm cover from either face. The distance between crosswires shall not exceed 400 mm . Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.14 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.15 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 16 mm thick and 10 mm thick flanges, with a tolerance of plus or minus 2 mm (1/16 inch) . The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 34 degrees C after five hours exposure, and shall have a durometer

hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.16 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07900JOINT SEALING.

2.17 INSULATION

2.17.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyisocyanurate shall conform to ASTM C 1289, Type I, Class 1 or 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.17.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 50 mm, and a minimum air space of 20 mm.

2.17.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 2 for the overall thickness. The aged R-value shall be determined at 24 degrees C in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.17.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.18 FLASHING

Flashing shall be as specified in Section 07600 SHEET METALWORK, GENERAL.

2.19 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 10 mm mortar joint.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 37 degrees C in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 4 degrees C, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 4 to 0 degrees C . Sand or mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C .

b. Air Temperature 0 to minus 4 degrees C . Sand and mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C . Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature minus 4 to minus 7 degrees C . Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C . Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 24 km/hour .

d. Air Temperature minus 7 degrees C and below. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C . Enclosure and auxiliary heat shall be provided to maintain air temperature above 0 degrees C . Temperature of units when laid shall not be less than minus 7 degrees C .

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 4 to 0 degrees C . Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 0 to minus 4 degrees C . Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature minus 4 to minus 7 degrees C . Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature minus 7 degrees C and Below. Masonry temperature shall be maintained above 0 degrees C for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 13 mm. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 13 mm into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 400 mm ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 200 mm .

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 3 mm . Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 0.155 gm per minute per square cm (1 gm per minute per square inch) of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm

Variation from level for bed joints and top surfaces of bearing walls	
In 3 m	6 mm
In 12 m or more	13 mm

Variations from horizontal lines	
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	6 mm
Plus	13 mm

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before

being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 300 mm wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm . On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm .

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm joints, except for prefaced concrete masonry units.

3.2.8.2 Prefaced Concrete Masonry Units

Prefaced concrete masonry units shall have a joint width of 10 mm wide on unfaced side and not less than 5 mm nor more than 6 mm wide on prefaced side.

3.2.8.3 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 100 mm above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 100 mm nominal thick units shall be tied to intersecting partitions of 100 mm units, 125 mm into partitions of 150 mm units, and 175 into partitions of 200 mm or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 100 mm thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement

assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 100 mm of coarse aggregate or 250 mm of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Weep holes shall be provided not more than 600 mm on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity and shall be above grade to prevent blockage. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 400 mm on center vertically and 600 mm on center horizontally. Unit ties shall be spaced not over 600 mm on centers horizontally, in courses not over 400 mm apart vertically, staggered in alternate courses. Ties shall be laid not closer than 16 mm to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 PREFACED CONCRETE MASONRY UNITS

Prefaced concrete masonry units shall be installed as specified for concrete masonry units and as required herein. Single-faced units may be installed through the wall where walls or partitions are indicated to have structural clay facing unit finish on one side only. The facing shall be used for dimensional and plane reference in the installation. Two-faced walls or partitions shall consist of two units bonded and tied together as specified for composite walls. Wainscots shall be of full courses to approximate as nearly as possible the height indicated, except that in no case shall the wainscots be lower than 50 mm below the specified height. Units shall be set level and true so that bases and walls will present true planes and surfaces free of waviness, offset, or other distortion. Joint reinforcing shall be placed not over 400 mm on center vertically.

3.7 NOT USED

3.8 NOT USED

3.9 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least

3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.10 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 50 mm of tops of walls.

3.10.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.10.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.11 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 400 mm on center or as indicated. Reinforcement shall be lapped not less than 150 mm . Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm cover to either face of the unit.

3.12 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each

course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.12.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m apart, or as required, to limit the horizontal flow of grout for each pour.

3.12.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.12.3 Grout Holes and Cleanouts

3.12.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 400 mm on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.12.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 1.5 m . Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 800 mm where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 75 by 100 mm openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.12.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work,

reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.12.4 Grouting Equipment

3.12.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.12.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.12.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 1.5 m in height. High-lift grout methods shall be used on pours exceeding 1.5 m in height.

3.12.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 13 mm into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.12.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and

from reinforcing steel. Mortar protruding more than 6 mm into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 1.2 m in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 300 to 450 mm into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
0.3	Fine	Low Lift	20	40 x 50
1.5	Fine	Low Lift	50	50 x 75
2.4	Fine	High Lift	50	50 x 75
3.6	Fine	High Lift	65	65 x 75
7.3	Fine	High Lift	75	75 x 75
0.3	Coarse	Low Lift	40	40 x 75
1.5	Coarse	Low Lift	50	65 x 75
2.4	Coarse	High Lift	50	75 x 75
3.6	Coarse	High Lift	65	75 x 75
7.3	Coarse	High Lift	75	75 x 100

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:

a) The required minimum dimensions of total clear areas given in

the table above;
b) The width of any mortar projections within the space;
c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 20 mm or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.13 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm shall be maintained between reinforcement and interior faces of units.

3.14 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 19 by 19 mm (3/4 by 3/4 inch) groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 20 mm; backer rod and sealant shall be installed in accordance with Section 07900 JOINT SEALING. Exposed interior control joints shall be raked to a depth of 6 mm . Concealed control joints shall be flush cut.

3.15 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.16 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 3 m and installed with a 6 mm gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 1.2 m, unless limited by

wall configuration.

3.17 LINTELS

3.17.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 13 mm above the bottom inside surface of the lintel unit.

3.18 NOT USED

3.19 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.19.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm on centers vertically and 600 mm on center horizontally.

3.19.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 400 mm on centers vertically, and if applicable, not over 600 mm on centers horizontally.

3.20 PARGING

The outside face of below-grade exterior concrete-masonry unit walls enclosing usable rooms and spaces, except crawl spaces, shall be parged with type S mortar. Parging shall not be less than 13 mm thick troweled to a smooth dense surface so as to provide a continuous unbroken shield from top of footings to a line 150 mm below adjacent finish grade, unless otherwise indicated. Parging shall be coved at junction of wall and footing. Parging shall be damp-cured for 48 hours or more before backfilling. Parging shall be protected from freezing temperatures until hardened.

3.21 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.22 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.23 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.23.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes. All exterior exposed CMU walls shall be sealed with a clear coating sealant.

3.23.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 30 mL trisodium phosphate and 30 mL laundry detergent to 1 L of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.23.3 Prefaced Concrete Masonry Unit Surfaces

Prefaced concrete masonry unit surfaces shall be cleaned with soap powder and clean water applied with stiff fiber brushes. Excess mortar shall be removed with wood paddles. Metal cleaning tools, metal brushes, abrasive powders, and acid solutions shall not be used. At the completion of cleaning operations, the surfaces shall be rinsed with clean water. In areas of traffic within the building, a barricade of wood supported by

framing lumber shall be erected to protect the units. In other areas, a heavy kraft-type building paper shall be taped over the units until final acceptance.

3.24 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.25 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.26 TEST REPORTS

3.26.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.26.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa at 28 days.

3.26.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

3.26.4 Prism Tests

At least one prism test sample shall be made for each 465 square meters of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ASTM E 447. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is

established by the tests of the materials used. Compressive strength shall not be less than 17.24 MPa at 28 days, for 300 mm CMU used in Building 2, OMS. If the compressive strength of any prism falls below the specified value by more than 3.5 MPa, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 3.5 MPa below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results shall be permitted.

-- End of Section --

SECTION 05090A

WELDING, STRUCTURAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec S335	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(1994) Standard Welding Terms and Definitions
AWS D1.1	(1998) Structural Welding Code - Steel
AWS Z49.1	(1999) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC ASD Spec S335 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near

the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

A pre-erection conference shall be held, prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using prequalified procedures). Attendees shall include all Contractor's welding production and inspection personnel and appropriate Government personnel. Items for discussion could include: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications; G, RE
Welder, Welding Operator, and Tacker Qualification; G, RE
Inspector Qualification; G, RE

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control; G, RE

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for

producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions

are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.

d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be

required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC ASD Spec S335. When AWS D1.1 and the AISC ASD Spec S335 specification conflict, the requirements of AWS D1.1 shall govern.

3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be

adjacent to the weld at 1 meter intervals. Identification with die stamps or electric etchers shall not be allowed.

3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings. Nondestructive testing shall be by visual inspection methods. The minimum extent of nondestructive testing shall be random 5 percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 05120A

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
AISC Design Guide No. 10	(1989) Erection Bracing of Low-Rise Structural Steel Frames
AISC FCD	(1999) Quality Certification Program
AISC LRFD Vol I	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol I: Structural Members, Specifications & Codes
AISC LRFD Vol II	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol II: Structural Members, Specifications & Codes
AISC Pub No. S303	(2000) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325M	(2000) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 36/A 36M	(2000a) Carbon Structural Steel
ASTM A 490M	(2000) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563M	(2000) Carbon and Alloy Steel Nuts (Metric)
ASTM A 6/A 6M	(2001) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 992/A 992M	(2000) Steel for Structural Shapes For Use in Building Framing
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(2000) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(2000) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Manual and AISC LRFD Vol II. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC LRFD Vol I and AISC LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1; except that welding for critical applications shall be in accordance with Section 05090A WELDING, STRUCTURAL or paragraph WELDING. High-strength bolting shall be in accordance with AISC LRFD Vol I.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural Steel System; G, AE
Structural Connections; G, AE

Shop and erection details including members (with their connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.

SD-03 Product Data

Erection; G, AE

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.

SD-07 Certificates

Mill Test Reports; G, AE

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified, prior to the installation.

Welder Qualifications

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

Welding Inspector

Welding Inspector qualifications.

Fabrication

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

1.5 WELDING INSPECTOR

Welding Inspector qualifications shall be in accordance with AWS D1.1

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 36/A 36M.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 Structural Shapes for Use in Building Framing

Wide flange shapes in accordance with ASTM A 992/A 992M shall be used where indicated on the drawings.

2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade C.

2.3 STEEL PIPE

Steel pipe shall conform to ASTM A 53/A 53M, Type E, Grade B.

2.4 NOT USED

2.5 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325M, Type 1 with carbon steel nuts conforming to ASTM A 563M , Grade C and DH.

2.6 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563M , Grade A.

2.7 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325M or ASTM A 490M bolts.

2.8 WASHERS

Plain washers shall conform to ASTM F 844. Other types, when required,

shall conform to ASTM F 436M.

2.9 PAINT

Paint shall conform to SSPC Paint 25.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category SBd structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC FCD and primed with the specified paint.

3.2 ERECTION

a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC LRFD Vol I. Erection plan shall be reviewed, stamped and sealed by a structural engineer licensed by the state in which the project is located.

b. For low-rise structural steel buildings (18 m tall or less and a maximum of 2 stories), the erection plan shall conform to AISC Pub No. S303 and the structure shall be erected in accordance withAISC Design Guide No. 10.

3.2.1 Structural Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Field welded structural connections shall be completed before load is applied.

3.2.2 Base Plates and Bearing Plates

Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2.3 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.3 WELDING

The contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including wleding done using prequalified procedures. Prequaliried procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

-- End of Section --

SECTION 05210A

STEEL JOISTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

STEEL JOIST INSTITUTE (SJI)

SJI Specs & Tables	(1994) Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Steel Joists; G, AE

Detail drawings shall include fabrication and erection details, specifications for shop painting, and identification markings of joists.

1.3 GENERAL REQUIREMENTS

Steel joists are designated on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition and stored off the ground in a well drained location, protected from damage, and easily accessible for inspection and handling.

PART 2 PRODUCTS

2.1 OPEN WEB STEEL JOISTS

Open web steel joists shall conform to SJI Specs & Tables, K-Series. Joists shall be designed to support the loads given in the standard load tables of SJI Specs & Tables.

2.2 NOT USED

2.3 JOIST GIRDERS

Joist girders shall conform to SJI Specs & Tables.

2.4 ACCESSORIES AND FITTINGS

Accessories and fittings, including end supports and bridging, shall be in accordance with the standard specifications under which the members were designed.

2.5 SHOP PAINTING

Joists and accessories shall be shop painted with a rust-inhibiting primer paint. For joists which will be finish painted under Section 09900 PAINTING, GENERAL, the primer paint shall be limited to a primer which is compatible with the specified finish paint.

PART 3 EXECUTION

3.1 ERECTION

Installation of joists shall be in accordance with the standard specification under which the member was produced. Joists shall be handled in a manner to avoid damage. Damaged joists shall be removed from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Joists shall be accurately set, and end anchorage shall be in accordance with the standard specification under which the joists were produced. Joist bridging and anchoring shall be secured in place prior to the application of any construction loads. Any temporary loads shall be distributed so that the carrying capacity of any joist is not exceeded. Loads shall not be applied to bridging during construction or in the completed work. Abraded, corroded, and field welded areas shall be cleaned and touched up with the same type of paint used in the shop painting.

3.2 BEARING PLATES

Bearing plates shall be provided with full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

-- End of Section --

SECTION 05300A

STEEL DECKING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec S335	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl	(1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI Diaphram Mnl	(1991) Diaphragm Design Manual
SDI Pub No 29	(1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (1991) Zinc-Rich Primers (Type I - "Inorganic" and Type II - "Organic")

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Deck Units; G, RE
Accessories; G, RE
Attachments; G, RE
Holes and Openings; G, RE

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded or fastener connections; and the manufacturer's erection instructions.

SD-03 Product Data

Deck Units; G, RE

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

Attachments; G, RE

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No 29. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated

in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI Cold-Formed Mnl, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.1.1 Roof Deck

Steel deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 653/A 653M. Roof deck units shall be fabricated of 0.91 mm design thickness or thicker steel and shall be galvanized, G90 coating class.

2.1.2 NOT USED

2.1.3 Composite Deck

Deck to receive concrete as a filler or for composite deck assembly shall conform to ASTM A 653/A 653M. Deck used as the tension reinforcing in composite deck shall be fabricated of 0.91 mm design thickness or thicker steel, and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class. Deck units used in composite deck shall have adequate embossment to develop mechanical shear bond to provide composite action between the deck and the concrete.

2.1.4 Form Deck

Deck used as a permanent form for concrete shall conform to ASTM A 653/A 653M. Deck used as a form for concrete shall be fabricated of 0.61 mm design thickness or thicker steel zinc-coated in conformance with ASTM A 653/A 653M, G60 coating class.

2.1.5 NOT USED

2.1.6 Shear Connectors

Shear connectors shall be headed stud type, ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC ASD Spec S335.

2.2 TOUCH-UP PAINT

Touch-up paint for zinc-coated units shall be an approved galvanizing repair paint with a high-zinc dust content. Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates

shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

2.4.2 Closure Plates for Composite Deck

The concrete shall be supported and retained at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Metal closures shall be provided for all openings in composite steel deck 6 mm and over, including but not limited to:

2.4.2.1 Cover Plates to Close Panels

Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in composite steel deck may receive a tape joint cover.

2.4.2.2 Column Closures to Close Openings

Column closures to close openings between steel deck and structural steel columns.

2.4.2.3 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 1.204 mm (0.0474 inch); welding washers, 1.519 mm (0.0598 inch); cant strip, 0.749 mm (0.0295 inch); other metal accessories, 0.909 mm (0.0358 inch); unless otherwise indicated. Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

PART 3 EXECUTION

3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI Pub No 29 and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or

deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be filled with concrete, used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

3.2 NOT USED

3.3 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 19 mm diameter puddle welds or fastened with screws, to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 29. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall not be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be lapped 50 mm. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI Diaphram Mnl. Shear connectors shall be attached as shown and shall be welded as per AWS D1.1 through the steel deck to the steel member.

3.4 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 150 mm across require no reinforcement. Holes and openings 150 to 300 mm across shall be reinforced by 1.204 mm (0.0474 inch) thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Holes and openings larger than 300 mm shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists. Openings must not interfere with seismic members such as chords and drag struts.

3.5 PREPARATION OF FIRE-PROOFED SURFACES

Deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, shall be galvanized and shall be free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Any required cleaning shall be done prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

-- End of Section --

SECTION 05500A

MISCELLANEOUS METAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1997) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3	(1992) Ladders - Fixed - Safety Requirements

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2000a) Carbon Structural Steel
ASTM A 475	(1998) Zinc-Coated Steel Wire Strand
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 26/B 26M	(1999) Aluminum-Alloy Sand Castings
ASTM B 429	(2000) Aluminum-Alloy Extruded Structural Pipe and Tube

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (1994) Metal Bar Grating Manual

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-344 (Rev B) Lacquer, Clear Gloss, Exterior, Interior

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Miscellaneous Metal Items; G, RE.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items:

Access doors and panels
Welded wire fabric
Pipe guards (Bollards)
Floor grating and frames
Handrails
Ladders
Miscellaneous metal items
Partitions, diamond mesh type
Floor mats
Steel door frames
Trench covers, frames, and liners
Overhead coiling doors frame
Corner guards
Ledge and shelf angles
Trash guard

SD-04 Samples

Miscellaneous Metal Items; G, RE.

Samples of the following items: Aluminum handrail. Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have standard mill finish or anodized finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used

in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.

1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS

Doors and panels shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 1.52 mm (16 gauge) steel with welded joints and finished with anchorage for securing into construction. Access doors shall be a minimum of 600 by 600 mm and of not lighter than 1.9 mm (14 gauge) steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch. Exposed metal surfaces shall have a shop applied prime coat. Provide rated panels to equal rating of wall being penetrated.

2.2 NOT USED

2.3 NOT USED

2.4 NOT USED

2.5 CORNER GUARDS AND SHIELDS

Corner guards and shields for jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end weld stud anchors. Corner guards for use with glazed or ceramic tile finish on walls shall be formed of 1.6 mm thick corrosion-resisting steel with polished or satin finish, shall extend 1.5 m above the top of cove base or to the top of the wainscot, whichever is less, and shall be securely anchored to the supporting wall. Corner guards on exterior shall be galvanized. Corner guards for use in the kitchen shall be stainless steel.

2.6 NOT USED

2.7 PIPE GUARDS (BOLLARDS)

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53/A 53M, Type E or S, weight STD, black finish.

2.8 DOWNSPOUT BOOTS

Downspout boots shall be cast iron with receiving bells sized to fit downspouts.

2.9 NOT USED

2.10 NOT USED

2.11 FLOOR GRATINGS AND FRAMES

Carbon steel and aluminum grating shall be designed in accordance with NAAMM MBG 531 to meet the indicated load requirements. Edges shall be banded with bars 6 mm less in height than bearing bars for grating sizes above 19 mm. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Steel floor gratings and frames shall be galvanized after fabrication.

2.12 FLOOR PLATES

Floor plates shall be 6 mm thick, raised thread steel.

2.13 NOT USED

2.14 HANDRAILS

Handrails shall be designed to resist a concentrated load of 890 N (200 pounds) in any direction at any point of the top of the rail or 292 Newtons per meter (20 pounds per foot) applied horizontally to top of the rail, whichever is more severe.

2.14.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails, including inserts in concrete, shall be steel pipe conforming to ASTM A 53/A 53M. Steel railings shall be 40 mm nominal size. Railings shall be hot-dip galvanized and shop painted primed. Pipe collars shall be hot-dip galvanized steel.

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 10 mm hexagonal recessed-head setscrews.

(2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 150 mm long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Removable sections, toe-boards, and brackets shall be provided as indicated.

2.14.2 Aluminum Handrails

Handrails shall consist of 40 mm nominal Schedule 40 pipe ASTM B 429. Railings and pipe collars shall be anodized. All fasteners shall be Series 300 stainless steel.

a. Jointing shall be by one of the following methods:

(1) Flush type rail fittings, welded and ground smooth with splice locks secured with 10 mm recessed head setscrews.

(2) Mitered and welded joints, made by fitting post to top rail and intermediate rail to post and corners, shall be groove welded and ground smooth. Splices, where allowed by the Contracting Officer, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 150 mm in length. Dowel or sleeve shall be connected to one side of the splice by tack welding or by using epoxy cement.

(3) Railings shall be assembled using slip-on aluminum-magnesium alloy fittings for joints. Fittings shall be fastened to pipe or tube with 6 mm or 10 mm stainless steel recessed head setscrews. Assembled railings shall be provided with fittings only at vertical supports or at rail terminations attached to walls. Expansion joints shall be at the midpoint of panels. A setscrew shall be provided in only one side of the slip-on sleeve. Alloy fittings shall conform to ASTM B 26/B 26M.

b. Removable sections, toe-boards and brackets shall be provided where indicated, using flange castings as appropriate.

2.15 GUY CABLES

Guy cables shall be prestretched, galvanized wire rope of the sizes indicated. Wire rope shall conform to ASTM A 475, high strength grade with Class A coating. Guys shall have a factory attached clevis top-end fitting; guys shall have a factory attached open-bridge strand socket bottom-end fitting; guys shall be complete with oval eye, threaded anchor rods. Fittings and accessories shall be hot-dip galvanized.

2.16 LADDERS

Ladders shall be galvanized steel or aluminum, fixed rail type in accordance with ANSI A14.3.

2.17 NOT USED

2.18 NOT USED

2.19 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous

mountings, and frames, shall be provided to complete the work.

2.20 PARTITIONS, DIAMOND MESH TYPE (OMAR FUNDED)

Partitions shall be constructed of metal fabric attached to structural steel framing members. Fabric shall be 10 gauge steel wires woven into 38 mm diamond mesh with wire secured through weaving channels. Framing members shall be channels 38 by 3 mm minimum size. Channel frames shall be mortised and tenoned at intersections. Steel frames, posts, and intermediate members shall be of the sizes and shapes indicated. Cast-iron floor shoes and caps shall have setscrew adjustment. Doors and grilles shall be provided as indicated, complete with hardware and accessories including sliding mechanisms, locks, guard plates, sill shelves and brackets, and fixed pin butts. Doors and grilles shall have cover plates as indicated. Dutch doors shall have a lock for each leaf. A continuous rubber bumper shall be provided at bottom of grille frame. Locks shall be bronze, cylinder, mortise type. Keying shall be coordinated with Section 08710 DOOR HARDWARE. Ferrous metal portions of partitions and accessories shall be galvanized.

2.21 NOT USED

2.22 ROOF SCUTTLES

Roof scuttles shall be of galvanized steel not less than 2.0 mm (14 gauge), with 75 mm beaded flange welded and ground at corners. Scuttle shall be sized to provide minimum clear opening of 940 by 760 mm. Cover and curb shall be insulated with 25 mm thick rigid insulation covered and protected by galvanized steel liner not less than 0.55 mm (26 gauge). The curb shall be equipped with an integral metal cap flashing of the same gauge and metal as the curb, full welded and ground at corners for weathertightness. Scuttle shall be completed assembled with heavy hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on inside and outside and neoprene draft seal. Heavy-Duty fasteners (HASP) shall be provided for padlocking on the inside. The cover shall be equipped with an automatic hold-open arm complete with handle to permit one hand release.

2.23 NOT USED

2.24 NOT USED

2.25 NOT USED

2.26 STEEL STAIRS

Steel stairs shall be complete with structural or formed channel stringers, metal pan cement-filled treads, landings, columns, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36/A 36M. Stairs and accessories shall be galvanized. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill. Gratings for treads and landings shall conform to NAAMM MBG 531. Grating treads shall have slip-resistant nosings.

2.27 STEEL DOOR FRAMES

Steel door frames built from structural shapes shall be neatly mitered and securely welded at the corners with all welds ground smooth. Jambs shall be provided with 50 by 6 by 300 mm bent, adjustable metal anchors spaced not over 760 mm on centers. Provision shall be made to stiffen the top member for all spans over 900 mm. Continuous door stops shall be made of 38 by 16 mm bars.

2.28 TRENCH COVERS, FRAMES, AND LINERS

Trench covers shall be designed to meet the indicated load requirements. Trench frames and anchors shall be all welded steel construction designed to match cover. Covers shall have flush drop handles formed of 6 mm round stock, and shall be cast-iron grating. Grating opening widths shall not exceed 25 mm. Trench liners shall be cast iron with integral frame for cover.

2.29 NOT USED

2.30 NOT USED

2.31 NOT USED

2.32 WINDOW SUB-SILL

Window sub-sill shall be of extruded aluminum alloy of size and design indicated. Not less than two anchors per window section shall be provided for securing into mortar joints of masonry sill course. Sills for banks of windows shall have standard mill finish with a protective coating, prior to shipment, of two coats of a clear, colorless, methacrylate lacquer applied to all surfaces of the sills.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 REMOVABLE ACCESS PANELS

A removable access panel not less than 300 by 300 mm shall be installed directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.3 NOT USED

3.4 NOT USED

3.5 INSTALLATION OF PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.6 INSTALLATION OF DOWNSPOUT BOOTS

Downspouts shall be secured to building through integral lips with appropriate fasteners.

3.7 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.7.1 Installation of Steel Handrails

Installation shall be in pipe sleeves embedded in concrete and filled with molten lead or sulphur with anchorage covered with standard pipe collar pinned to post, masonry with expansion shields and bolts or toggle bolts or base plates welded to stringers or structural steel framework. Rail ends shall be secured by steel pipe flanges anchored by expansion shields and bolts or through-bolted to a back plate or by 6 mm lag bolts to studs or solid backing.

3.7.2 Installation of Aluminum Handrails

Installation shall be by means of flanges anchored to concrete or masonry by expansion shields, base plates or flanges bolted to stringers or structural steel framework or flanges through-bolted to a back plate or by 6 mm lag bolts to studs or other structural members. Bolts used to anchor aluminum alloy flanges shall be stainless steel of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphalt varnish.

3.8 NOT USED

3.9 NOT USED

3.10 PARTITION POSTS AND OPENINGS

Posts shall be set in shoes bolted to the floor and in caps tap-screwed to clip angles in overhead construction, as indicated. Openings shall be formed using channels similar to the partition frames at ducts, pipes, and other obstructions.

3.11 RECESSED FLOOR MATS

Contractor shall verify field measurements prior to releasing materials for fabrication by the manufacturer. A mat frame shall be used to ensure recess accuracy in size, shape and depth. Drain pit shall be formed by

blocking out concrete when frames are installed. Pit shall be dampproofed after concrete has set. Frames shall be assembled onsite and installed so that upper edge will be level with finished floor surface. A cement base shall be screeded inside the mat recess frame area using the edge provided by the frame as a guide. The frame shall be anchored into the cement with anchor pins a minimum of 610 mm on centers.

3.12 NOT USED

3.13 NOT USED

3.14 DOOR FRAMES

Door frames shall be secured to the floor slab by means of angle clips and expansion bolts. Continuous door stops shall be welded to the frame or tap screwed with countersunk screws at no more than 450 mm centers, assuring in either case full contact with the frame. Any necessary reinforcements shall be made and the frames shall be drilled and tapped as required for hardware.

3.15 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

-- End of Section --

SECTION 06100A

ROUGH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T11	(1988) Manual for Wood Frame Construction

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC TC Manual	(1994) Timber Construction Manual
AITC 111	(1979) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM C 79/C 79M	(2000) Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2000) Mineral Fiber Block and Board Thermal Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation

ASTM C 1177/C 1177M	(1999) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2898	(1994; R 1999) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM E 96	(2000) Water Vapor Transmission of Materials
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(2000) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C9	(1997) Plywood - Preservative Treatment by Pressure Processes
AWPA C20	(1999) Structural Lumber Fire-Retardant Pressure Treatment
AWPA C27	(1999) Plywood - Fire-Retardant Pressure Treatment
AWPA M4	(1999) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(2000) Standards for Waterborne Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA EWS R540C	(1996) Builder Tips Proper Storage and Handling of Glulam Beams
APA EWS T300C	(1997) Technical Note Glulam Connection Details
APA PRP-108	(1980; Rev Jan 1996) Performance Standards and Policies for Structural-Use Panels

REDWOOD INSPECTION SERVICE (RIS)

RIS GCRL	(1997) Standard Specifications for Grades of California Redwood Lumber

U.S. DEPARTMENT OF COMMERCE (DOC)

PS-1	(1996) Voluntary Product Standard - Construction and Industrial Plywood
PS-2	(1992) Performance Standards for Wood-Based Structural-Use Panels

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM LPD 1-49	(1995) Loss Prevention Data Sheet - Perimeter Flashing

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(1994) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(1997) Standard Grading Rules for Northeastern Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Specs	(1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules	(1994; Supple 8 thru 11) Standard Grading Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI 1	(1995; Errata) National Design Standard for Metal Plate-Connected Wood Truss Construction and Commentary; and Apendix 1

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	(1996; Supples VII(A-E), VIII(A-C)) Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules	(1999) Western Lumber Grading Rules 95

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural Wood Members; G, RE
Installation of Framing; G, RE

Drawings of structural laminated members, fabricated wood trusses, engineered wood joists and rafters, and other fabricated structural members indicating materials, shop fabrication, and field erection details; including methods of fastening.

Nailers and Nailing Strips

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-03 Product Data

Structural Wood Members; G, RE

Design analysis and calculations of structural laminated members, fabricated wood trusses, and other fabricated structural members showing design criteria used to accomplish the applicable analysis.

Product Installations; G, RE

List containing name and location of successful installation of similar type of fabricated structural members specified herein.

SD-07 Certificates

Grading and Marking; G, RE

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Insulation; G, RE

Certificate attesting that the cellulose, perlite, glass and mineral fiber, glass mat roof board, polyurethane, or

polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

2.1.1.2 NOT USED

2.1.1.3 Plywood and Other Sheathing Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

a. Wood members in contact with or within 455 mm of soil.

b. Wood members in contact with water.

c. Wood members exposed to the weather including those used in builtup roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing as a base for wood siding.

d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.

e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

a. 4 kg per cubic meter (0.25 pcf) intended for above ground use.

b. 6.4 kg per cubic meter (0.40 pcf) intended for ground contact and fresh water use.

2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

a. 4 kg per cubic meter (0.25 pcf) intended for above ground use.

b. 6.4 kg per cubic meter (0.40 pcf) intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber Except Roof Planking: 100 mm or less, nominal thickness, 19 percent maximum. 125 mm or more, nominal thickness, 23 percent maximum in a 75 mm perimeter of the timber cross-section.

b. Roof Planking: 15 percent maximum.

c. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 Fire-Retardant Treatment

Fire-retardant treated wood shall be pressure treated in accordance with AWPA C20 for lumber and AWPA C27 for plywood. Material use shall be defined in AWPA C20 and AWPA C27 for Interior Type A and exterior type.

Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D 2898 prior to being tested for compliance with AWPA C20 or AWPA C27. Items to be treated include: Wood blocking installed in rated walls.

2.1.6 NOT USED

2.1.7 Sheathing

Sheathing shall be fiberboard, gypsum board, plywood, wood structural panels, or wood for wall sheathing; and plywood, wood structural panels, or wood for roof sheathing.

2.1.7.1 NOT USED

2.1.7.2 Gypsum Sheathing Board

Glass mat gypsum sheathing shall conform to ASTM C 79/C 79Mand ASTM C 1177/C 1177M. Gypsum board shall conform to ASTM C 79/C 79M, 13 mm thick, 1200 mm wide with straight edges for supports 400 mm on center without corner bracing of framing or for supports 600 mm on center with corner bracing of framing; 600 mm wide with V-tongue and groove edges for supports 400 or 600 mm on center with corner bracing of framing.

2.1.7.3 Plywood

Plywood shall conform to PS-1, APA PRP-108 or PS-2, Grade C-D or sheathing grade with exterior glue. Sheathing for roof and walls without corner bracing of framing shall have a span rating of 16/0 or greater for supports 400 mm on center and a span rating of 24/0 or greater for supports 600 mm on center.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

2.2.3 Clip Angles

Steel, 5 mm (3/16 inch) thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood

members.

2.2.4 Expansion Shields

Type and size best suited for intended use.

2.2.5 NOT USED

2.2.6 NOT USED

2.2.7 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 25 mm into supports. In general, 8-penny or larger nails shall be used for nailing through 25 mm thick lumber and for toe nailing 50 mm thick lumber; 16-penny or larger nails shall be used for nailing through 50 mm thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T01. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.2.8 Timber Connectors

Unless otherwise specified, timber connectors shall be in accordance with TPI 1, APA EWS T300C or AITC TC Manual.

2.3 INSULATION

Thermal resistance of insulation shall be not less than R-values shown. R-values shall be determined at 24 degrees C in accordance with ASTM C 518. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

2.3.1 Batt or Blanket

2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation. Insulation shall have a 0.25 mm (10 mil) thick, white, puncture resistant woven-glass cloth with vinyl facing on one side. Width and length shall suit construction conditions.

2.3.1.2 Mineral Fiber Batt

Mineral fiber batt shall conform to ASTM C 665, Type I unfaced insulation.

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 Rigid Insulation

2.3.4.1 Polystyrene Board

Polystyrene board shall be extruded and conform to ASTM C 578, Type IV.

2.3.4.2 Polyurethane or Polyisocyanurate Board

Polyurethane or polyisocyanurate board shall have a minimum recovered material content of 9 percent by weight of core material in the polyurethane or polyisocyanurate portion. Unfaced preformed polyurethane shall conform to ASTM C 591. Faced polyisocyanurate shall conform to ASTM C 1289.

2.3.4.3 Glass Fiber or Insulation Board

Glass mat gypsum roof board shall conform to ASTM C 1177/C 1177M, flame spread 0, smoke developed 0, psi 500, water resistant. Glass fiber or insulation board shall conform to ASTM C 612, Type 1A with a minimum recovered material content of 9 percent by weight of glass fiber core material.

2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 29 ng per Pa per second per square meter (0.5 perms) as determined in accordance with ASTM E 96, unless otherwise specified.

2.5 AIR INFILTRATION BARRIER

Air infiltration barrier shall be building paper meeting the requirements of ASTM C 1136, Type IV, style optional or a tear and puncture resistant olefin building wrap (polyethylene or polypropylene) with a moisture vapor transmission rate of 125 g per square meter per 24 hours in accordance with ASTM E 96, Desiccant Method at 23 degrees C or with a moisture vapor transmission rate of 670 g per square meter per 24 hours in accordance with ASTM E 96, Water Method at 23 degrees C.

PART 3 EXECUTION

3.1 INSTALLATION OF FRAMING

3.1.1 General

General framing shall be in accordance with AF&PA T11.Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Members shall be framed for passage of ducts. Members shall be cut, notched, or bored in accordance with applicable requirements

of AF&PA T01 for the passage of pipes, wires, or conduits. Rafters, purlins, and joists shall be set with crown edge up. Framing shall be kept at least 50 mm away from chimneys and 100 mm away from fireplace backwalls. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

3.2 INSTALLATION OF SHEATHING

3.2.1 NOT USED

3.2.2 Gypsum Board

Sheathing shall be applied with edges in light contact at joints and nailed in accordance with the manufacturer's approved instructions. Sheets 600 mm wide shall be applied horizontally with tongued edge up, with vertical joints over supports, and with vertical joints staggered. Sheets 1200 mm wide shall be applied vertically, extended over top and bottom plates, and with all vertical and horizontal joints over supports.

3.2.3 Plywood and Wood Structural Panels

Sheathing shall be applied with edges 3 mm apart at side and end joints, and nailed at supported edges at 150 mm on center and at intermediate supports 300 mm on center unless otherwise shown. Nailing of edges shall be 10 mm from the edges. Wall sheathing shall extend over top and bottom plates, and if applied horizontally the vertical joints shall be made over supports and staggered. Wall sheathing over which wood shingles are to be applied shall be applied horizontally. Roof sheathing shall be applied with long dimension at right angles to supports, end joints made over supports, and end joints staggered.

3.2.4 Wood

Sheathing end joints shall be made over framing members and so alternated that there will be at least two boards between joints on the same support. Each board shall bear on at least three supports. Boards shall be nailed at each support using two nails for boards 150 mm and less in width and three nails for boards more than 150 mm in width. Roof sheathing shall not be installed where roof decking is installed.

3.3 NOT USED

3.4 NOT USED

3.5 NOT USED

3.6 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

3.6.1 NOT USED

3.6.2 NOT USED

3.6.3 Blocking

Blocking shall be provided as necessary for application of siding, sheathing, subflooring, wallboard, and other materials or building items, and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 2400 mm for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

3.6.4 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 450 mm on center and staggered. Beginning and ending nails shall not be more than 150 mm for nailer end. Ends of stacked nailers shall be offset approximately 300 mm in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPD 1-49.

3.6.5 Wood Grounds

Wood grounds shall be provided as necessary for attachment of trim, finish, and other work to plaster. Grounds shall be run in lengths as long as practicable, butt jointed, and rigidly secured in place.

3.6.6 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 400 mm on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

3.6.7 Rough Bucks and Frames

Rough bucks shall be set straight, true, and plumb, and secured with anchors near top and bottom of each wood member and at intermediate intervals of not more than 900 mm. Anchors for concrete shall be expansion bolts, and anchors for masonry shall be 5 x 32 mm (3/16 x 1-1/4 inch) steel straps extending not less than 200 mm into the masonry and turned down 50 mm into the masonry.

3.6.8 Wood Bumpers

Wood bumpers shall be bored, countersunk and securely bolted in place.

3.6.9 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more

than 1800 mm on centers and not more than 300 mm from end of each piece. A minimum of two anchors shall be used for each piece.

3.7 NOT USED

3.8 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the thermal resistance shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.9 INSTALLATION OF VAPOR RETARDER

Vapor retarder shall be applied to provide a continuous barrier at window and door frames, and at all penetrations such as electrical outlets and switches, plumbing connections, and utility service penetrations. Joints in the vapor retarder shall be lapped and sealed according to the manufacturer's recommendations.

3.10 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.11 INSTALLATION OF AIR INFILTRATION BARRIER

Air infiltration barrier shall be installed in accordance with the manufacturer's recommendations.

3.12 TABLES

TABLE I. SPECIES AND GRADE

Subflooring, Roof Sheathing, Wall Sheathing, Furring

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
NHLA Rules					
	Cypress			X	
NELMA Grading Rules					
	Northern White Cedar				X
	Eastern White Pine	X			
	Northern Pine	X			
	Balsam Fir				X
	Eastern Hemlock-Tamarack				X
RIS GCRL					
	Redwood		X		
SCMA Specs					
	Cypress			X	
SPIB Rules					
	Southern Pine		X		
WCLIB 17					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Sitka Spruce	X			
	Mountain Hemlock	X			
	Western Cedar	X			
WWPA Grading Rules					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
NHLA Rules			
	Red Oak	X	
NELMA Grading Rules			
	Northern Pine		X
	Eastern Hemlock-Tamarack		X
SPIB Rules			
	Southern Pine	X	
WCLIB 17			
	Douglas Fir-Larch		X
	Hem-Fir		X
WWPA Grading Rules			
	Douglas Fir-Larch		X
	Hem-Fir		X
	Douglas Fir-South		X

-- End of Section --

SECTION 06200A

FINISH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Based Materials

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1999) Architectural Woodwork Quality Standards

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(1997) Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS)

RIS GCRL	(1987) Grades of California Redwood Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec	(1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules	(1994; Supple 8 thru 11) Standard Grading Rules for Southern Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	(1996; Supples VII(A-E), VIII(A-C)) Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules	(1999) Western Lumber Grading Rules 95

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Finish Carpentry; G, RE

Drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

SD-03 Product Data

Wood Items, Trim; G, RE

Manufacturer's printed data indicating the usage of engineered or recycled wood products, and environmentally safe preservatives.

SD-04 Samples

Trim; G, RE

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well-ventilated areas, and protected from extreme changes in temperature and humidity.

PART 2 PRODUCTS

2.1 WOOD ITEMS, TRIM

The Contractor shall furnish products which optimize design by reducing the amount of wood used (engineered wood), by using recycled wood products and preservatives without arsenic or chromium when the products and methods are competitive in price or directed by the Contracting Officer.

2.1.1 Grading and Marking

Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements

for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Except for plywood, wood structural panels, and lumber, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

2.1.2 Sizes and Patterns

Lumber sizes and patterns shall conform to rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Sizes and patterns for materials other than lumber shall conform to requirements of the rules or standards under which produced. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Moisture Content

The maximum moisture content of untreated trim shall be 15 percent at the time of delivery to the jobsite and when installed.

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 NOT USED

2.1.9 Trim

2.1.9.1 Wood

Trim shall be species and grade listed in TABLE I at the end of this section. Sizes shall be as indicated.

2.2 NAILS

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Screws for use where nailing is impractical shall be size best suited for purpose.

PART 3 EXECUTION

3.1 NOT USED

3.2 NOT USED

3.3 NOT USED

3.4 INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints per AWI Qual Stds. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 TABLES

TABLE I. SPECIES AND GRADE TABLES FOR INTERIOR TRAY

Grading Rules	Species	Choice	Clear	C Select	C & Better
NELMA Grading Rules					
	Eastern Cedar				X
	Eastern Hemlock		X		
	Tamarack				X
	Eastern W. Pine				X
	Northern Pine				X
	Eastern Spruce			X	
	Balsam Fir		X		
RIS GCRL	Redwood		X		
SCMA Spec	Cypress			X	
SPIB Rules	Southern Pine				X
WCLIB 17	Douglas Fir			X	
	Larch				X
	Hemlock Fir				X
	Mountain Hemlock				X
	Sitka Spruce				X
WWPA Grading Rules					
	Douglas Fir				X
	Larch				X
	Hemlock Fir		X		
	Mountain Hemlock				X
	Western Larch		X		
	Idaho White Pine	X			
	Lodgepole Pine		X		
	Ponderosa Pine		X		
	Sugar Pine		X		
	Englemann Spruce		X		

TABLE I. SPECIES AND GRADE TABLES FOR INTERIOR TRAY

Grading Rules	Species	Choice	Clear	C Select	C & Better
	Douglas Fir South		X		
	Subalpine Fir		X		

NOTE 1: Western Cedar under WCLIB 17 shall be Grade B; and under WWPA Grading Rules, Western Cedar shall be Grade B bevel for siding and Grade A for trim.

NOTE 2: Except as specified in NOTE 3 below, siding and exterior trim shall be any of the species listed above. Interior trim shall be any one of the species listed above and the highest grade of the species for stain or natural finish and one grade below highest grade of species for paint finish.

NOTE 3: Southern Yellow Pine, Douglas Fir, Larch, Western Larch, and Tamarack shall not be used where painting is required and may be used on exterior work only when approved and stained with a preservative type stain.

-- End of Section --

SECTION 06410A

LAMINATE CLAD ARCHITECTURAL CASEWORK (MAILROOM CASEWORK)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2	(1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure
ANSI A208.2	(1994) Medium Density Fiberboard (MDF)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Based Materials

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1999) Architectural Woodwork Quality Standards

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates
NEMA LD 3.1	(1995) Performance, Application, Fabrication, and Installation of High-Pressure Decorative Laminates

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

NWWDA I.S. 1-A	(1997) Architectural Wood Flush Doors

1.2 GENERAL DESCRIPTION

Work in this section includes laminate clad custom casework as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings

or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09900 PAINTING, GENERAL.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. All items designated with a "G", including product literature, calculations, component data, certificates, diagrams, drawings, and samples shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Shop Drawings; G, RE
Installation; G, RE

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

SD-03 Product Data

Wood Materials; G, RE
Wood Finishes; G, RE
Finish Schedule; G, RE

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Qual Stds for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Plastic Laminates; G, RE

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 120 by 170 mm in size.

Cabinet Hardware; G, RE

One sample of each cabinet hardware item specified to include and Mounting Hardware.

SD-07 Certificates

Quality Assurance; G, RE
Laminate Clad Casework; G, RE

A quality control statement which illustrates compliance with and understanding of AWI Qual Stds requirements, in general, and the specific AWI Qual Stds requirements provided in this specification. The quality control statement shall also certify a minimum of ten years contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the custom grade quality standards as outlined in AWI Qual Stds, Section 400G and Section 400B for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Qual Stds requirements for the quality grade indicated.

1.5 NOT USED

1.6 DELIVERY AND STORAGE

Casework may be delivered knockdown or fully assembled. All units shall be delivered to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.7 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be

installed before finished flooring materials are installed.

1.8 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings before fabrication.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 NOT USED

2.1.2 Panel Products

2.1.2.1 NOT USED

2.1.2.2 NOT USED

2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in ANSI A208.2.

2.2 NOT USED

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings and in Section 09915 COLOR SCHEDULE. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 1.22 mm (plus or minus 0.127 mm) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.71 mm (plus or minus 0.012 mm) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 1.07 mm (plus or minus 0.127 mm) in thithickness. This laminate grade is intended for horizontal surfaces where post forming is required.

2.3.4 NOT USED

2.3.5 NOT USED

2.3.6 NOT USED

2.3.7 NOT USED

2.3.8 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.51 mm . Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

2.9 ADHESIVES, CAULKS, AND SEALANTS

2.9.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

2.9.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use polyvinyl acetate resin emulsion. Adhesives shall withstand a bond test as described in NWWDA I.S. 1-A.

2.9.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistant with AWI and laminate manufacturer's recommendations.

2.9.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.9.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.10 NOT USED

2.11 NOT USED

2.12 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI custom grade unless otherwise indicated in this specification.

2.12.1 NOT USED

2.12.2 NOT USED

2.12.3 NOT USED

2.12.4 NOT USED

2.12.5 Shelving

Shelving shall be fabricated from 19 mm medium density fiberboard (MDF). All shelving top and bottom surfaces shall be finished with HPDL plastic laminate. Shelf edges shall be finished in a HPDL plastic laminate.

2.12.5.1 Shelf Support System

The shelf support system shall be:

a. Surface-mounted metal shelf standards. Standards shall be positioned and spaced on the walls as shown in the drawings. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface when brackets are in place.

2.12.6 Laminate Clad Countertops

Laminate countertop substrate shall be constructed of 19 mm medium density fiberboard (MDF). A balanced backer sheet is required.

2.12.6.1 Edge Style

Front and exposed side countertop edges shall be in shapes and to dimensions as shown on the drawings. The countertop edge material shall be:

a. Post formed plastic laminate. Laminate edge shall be integral with countertop surface. Shape and profile shall be waterfall and to dimensions as indicated on the drawings.

b. Hardwood. Species, finish, profile, shape, and dimensions shall be as indicated on the drawings. Hardwood edge shall overlap the exposed countertop laminate edge and shall be installed flush with the countertop laminate surface.

c. Vinyl. Vinyl tee-mould edge shall be in shape, thickness, and color as indicated on the drawings. Tee mould edge shall overlap the exposed countertop laminate edge and shall be installed flush with the countertop laminate surface.

d. Plastic laminate Self Edge. Flat, 90 degree "self " edge. Edge must be applied before top. Laminate edge shall overlap countertop laminate and shall be eased to eliminate sharp corners.

2.12.6.2 Laminate Clad Splashes

Countertop splash substrate shall be 19 mm MDF fiberboard. Laminate clad backsplash shall be integral with countertop, coved to radius and to dimensions as indicated on the drawings. Side splashes shall be straight profile and provided loose, to be installed at the time of countertop installation. Back and side splash laminate pattern and color shall match the adjacent countertop laminate.

2.12.7 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3.1, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to NEMA LD 3.1 and ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Adjustable Shelving.

1) Top and bottom surfaces: HPDL Grade HGS.

2) All edges: HPDL Grade VGS.

b. Countertops and Splashes.

1) All exposed and semi-exposed surfaces: HPDL Grade HGP

2.12.7.1 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Qual Stds custom grade requirements.

2.12.8 Finishing

2.12.8.1 Filling

No fasteners shall be exposed on laminated surfaces.

2.12.8.2 NOT USED

2.12.8.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule and drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Qual Stds custom quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Wall

Laminated support panels shall utilize a wall anchoring system as detailed on the drawings.

3.1.2 Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk.

3.1.2.1 Loose Splashes

Loose side splashes shall be adhered to both the countertop surface perimeter and the adjacent wall surface with adhesives appropriate for the type of materials to be adhered. Joints between the countertop surface and splash shall be filled with clear silicone caulk in a smooth consistent concave bead. Bead size shall be the minimum necessary to fill the joint and any surrounding voids or cracks.

-- End of Section --

SECTION 06650

SOLID POLYMER (SOLID SURFACING) FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile
ANSI Z124.3	(1995) Plastic Lavatories
ANSI Z124.6	(1997) Plastic Sinks

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 570	(1998) Water Absorption of Plastics
ASTM D 638M	(1998) Tensile Properties of Plastics (Metric)
ASTM D 696	(1998) Coefficient of Linear Thermal Expansion of Plastics Between Minus 30 degrees C and 30 degrees C
ASTM D 2583	(1995) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM G 22	(1976; R 1996) Determining Resistance of Plastics to Bacteria

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High Pressure Decorative Laminates

1.2 GENERAL DESCRIPTION

Work in this section includes bathroom vanity tops, interior window sills,

and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, RE
Installation; G, RE

Shop Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

SD-03 Product Data

Solid polymer material; G, RE
Qualifications
Fabrications

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, sealants, and heat reflective tape. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Material; G, RE

A minimum 100 by 100 mm sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

Counter and Vanity Tops; G, RE

A minimum 300 mm wide by 150 mm deep, full size sample for each type of counter top shown on the project drawings. The sample shall include the edge profile and backsplash as detailed on the project drawings. Solid polymer material shall be of a pattern and color as indicated on the drawings. Sample shall include at least one seam. Approved sample shall be retained as

standard for this work.

SD-06 Test Reports

Solid polymer material; G, RE

Test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

SD-07 Certificates

Fabrications
Qualifications

Solid polymer manufacturer's certification attesting to fabricator qualification approval.

SD-10 Operations and Maintenance Data

Solid polymer material
Celean-up

A minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided,if available. Maintenance kit for matte finishes shall be submitted.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

PART 2 PRODUCTS

2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting ANSI Z124.3 and ANSI Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.25 mm shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 6 mm in thickness.

2.1.1 Cast,100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	422 kg/cm^2	ASTM D 638M
Hardness	55-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.0000386cm/cm/degC	ASTM D 696
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
6.4 mm sheet	910 mm, 227 g ball, no failure	
12.7 mm sheet	3550 mm, 227 g ball, no failure	
19 mm sheet	5070 mm, 227 m ball, no failure	
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 22
Liquid Absorption (Weight in 24 hrs.)	0.1% max.	ASTM D 570

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Flammability		ASTM E 84
Flame Spread	25 max.	
Smoke Developed	30 max	

2.1.2 NOT USED

2.1.3 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be in accordance with Section 09915 COLOR SCHEDULE. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

2.1.4 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be matte; gloss rating of 5-20.

2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting ANSI A136.1, Underwriter's Laboratories (UL) listed. This adhesive shall be used to bond solid polymer components to adjacent and underlying substrates.

2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and UL listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

2.2.4 Conductive Tape

Conductive tape shall be manufacturer's standard foil tape, 4 mils thick, applied around the edges of cut outs containing hot or cold appliances.

2.3 FABRICATIONS

Components shall be factory or shop fabricated to the greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and manufacturer's requirements. Factory cutouts shall be provided for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 13 mm thick solid surfacing material and shall be 100 mm high. Backsplashes and end splashes shall be provided for all counter tops and vanity tops. Backsplashes shall be shop fabricated and be permanently attached.

2.3.3.1 Permanently Attached Backsplash

Permanently attached backsplashes shall be attached with seam adhesive and to form a radiused coved transition from countertop to backsplash.

2.3.3.2 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 NOT USED

2.3.5 Window Stools

Window stools shall be fabricated from 19 mm thick solid surfacing, solid polymer material. Dimensions, edge shape, and other details shall be as indicated on the drawings.

2.3.6 Counter and Vanity Tops

All solid surfacing, solid polymer counter top and vanity top components

shall be fabricated from 13 mm thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with 100 mm high permanently attached with coved transition backsplash and loose endsplashes at all locations. Attach 50 mm wide reinforcing strip of polymer material under each horizontal counter top seam.

2.3.6.1 NOT USED

2.3.6.2 Vanity Tops With Bowls

A. Vitreous China Bowl

Countertops with vitreous china bowls shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china self-rimming installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 15400 PLUMBING,GENERAL PURPOSE.

2.3.7 NOT USED

2.3.8 NOT USED

2.3.9 NOT USED

PART 3 EXECUTION

3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, countertops, shelving, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

3.2 INSTALLATION

3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work. Metal or vitreous china sinks and lavatory bowls shall be attached to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Solid polymer sinks and bowls shall be installed using a color-matched seam adhesive. Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400

PLUMBING, GENERAL PURPOSE.

3.2.1.1 Loose Counter Top Splashes

Loose splashes shall be mounted in locations as noted on the drawings. Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Adhesion of particulate patterned solid polymer splashes to counter tops shall utilize a clear silicone sealant.

3.2.2 Silicone Sealant

A clear, silicone sealant or caulk shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

3.2.3 Plumbing

Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400.

3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made.

-- End of Section --

SECTION 07110A

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 1227	(1995) Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D 4479	(1993) Asphalt Roof Coatings - Asbestos Free

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fibrated Emulsion-Based Asphalt: Asphaltic Primer; Fibrated Asphalt;

SD-07 Certificates

Materials; G, RE

Certificates attesting that the materials meet the requirements specified.

1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous dampproofing work specified to meet the requirements of the contract.

1.4 DELIVERY, STORAGE AND HANDLING

Dampproofing materials shall be delivered to the project site in the original sealed containers bearing the name of manufacturer, contents and brand name, and stored in a weathertight enclosure to prevent moisture damage and absorption. Dampproofing materials shall be protected from freezing. Asphalt shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup; and therefore, shall not be used to cover dampproofing materials. Care shall be taken during storage to avoid separation or settlement of the emulsion components. Damaged or deteriorated materials shall be removed from the project site.

PART 2 PRODUCTS

2.1 EMULSION-BASED ASPHALT DAMPPROOFING

2.1.1 Fibrated Emulsion-Based Asphalt

Fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 1227 Type IV, asbestos-free, manufactured of refined asphalt, emulsifiers and selected clay, fibrated with mineral fibers. For spray or brush application, emulsion shall contain a minimum of 59 percent solids by weight, 56 percent solids by volume. For trowel application, emulsion shall contain a minimum of 58 percent solids by weight, 55 percent solids by volume.

2.2 SOLVENT-BASED ASPHALT DAMPPROOFING

2.2.1 Asphaltic Primer

Primer for cold-applied solvent-based asphalt dampproofing shall conform to ASTM D 41, asbestos-free, non-fibrated, manufactured with highly ductile soft asphalts and selected hydrocarbons.

2.2.2 Fibrated Asphalt

Fibrated solvent-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 4479 Type I, asbestos-free, manufactured with selected asphalts, stabilizers, mineral spirits and fibrated with mineral fibers. Solvent-based asphalt shall contain 72 percent solids by weight, 65 percent solids by volume.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous dampproofing shall be prepared in accordance with dampproofing manufacturer's recommendations. Surface preparation shall be approved prior to dampproofing application.

3.1.1 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work.

Drains and conductors shall be protected from clogging with asphalt.

3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry.

3.1.3 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage the dampproofing materials and impair performance shall be repaired. Rough surfaces shall be parged with a well-adhering coat of cement mortar.

3.1.4 Metal Surfaces

Metal surfaces shall be dry and be free of rust, scale, loose paint, oil, grease, dirt, frost and debris.

3.2 APPLICATION OF BITUMINOUS DAMPPROOFING

3.2.1 Emulsion-Based Asphalt

Emulsion-based asphalt dampproofing work shall not be performed in temperatures below 4 degrees C. Emulsions shall have a smooth and uniform consistency at time of application. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film of not less than 0.3 mm (12 mils) thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

a. Primer: 0.2 liters per square meter (1/2 gallon per 100 square feet), cold-applied.

b. Fibrated Dampproofing: 0.8 liters per square meter (2 gallons per 100 square feet), cold-applied with spray, brush or trowel.

3.2.2 Solvent-Based Asphalt

Solvent-based asphalt dampproofing work shall not be performed in temperatures below 4 degrees C. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film not less than 0.3 mm (12 mils) thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

a. Primer: 0.4 liters per square meter (1/2 gallon per 200 square feet), cold-applied.

b. Dampproofing Coat: 0.8 liters per square meter (2 gallons per 100 square feet), cold-applied with spray, brush or trowel.

3.3 CLEAN-UP

Surfaces of other work which are stained with dampproofing materials shall be cleaned with a cleaner recommended by dampproofing manufacturer.

3.4 PROTECTION

The completed dampproofing work shall be protected from damage during and after construction.

-- End of Section --

SECTION 07132A

BITUMINOUS WATERPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 173	(1997b) Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing
ASTM D 449	(1989; R 1999el) Asphalt Used in Dampproofing and Waterproofing
ASTM D 1327	(1997a) Bitumen-Saturated Woven Burlap Fabrics Used in Roofing and Waterproofing
ASTM D 1668	(1997a) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 4586	(1993; R 1999) Asphalt Roof Cement, Asbestos Free

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Reinforcing Fabric
Protection Board

Manufacturer's data including technical information which indicates full compliance with this section.

Applications

Manufacturer's installation instructions, before delivery of materials to the site. Instructions shall specify acceptable range of asphalt application temperatures and the maximum temperature for holding asphalt in a heated condition.

SD-07 Certificates

Materials

Certificates from manufacturer attesting that asphalt manufactured and shipped to jobsite meets the specified requirements.

1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous waterproofing work specified to meet the requirements of the contract.

1.4 DELIVERY, STORAGE AND HANDLING

Waterproofing materials shall be delivered to the project site in the original sealed containers bearing the name of the manufacturer, contents and brand name. Asphalt shall be protected from freezing in a weathertight enclosure. Reinforcement fabrics shall be protected from moisture damage and moisture absorption in a weathertight enclosure or shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup and therefore shall not be used to cover waterproofing materials. Damaged or deteriorated materials shall be removed from project site.

PART 2 PRODUCTS

2.1 ASPHALT WATERPROOFING

2.1.1 Primer

Primer for hot-applied asphalt waterproofing shall conform to ASTM D 41, asbestos-free, non-fibrated, manufactured with highly ductile soft asphalts and selected hydrocarbons.

2.1.2 NOT USED

2.1.3 Below-Grade Hot-Applied Asphalt

Hot-applied asphalt for below-grade applications shall conform to ASTM D 449, Type I, asbestos-free, manufactured from crude petroleum, suitable for use with membrane waterproofing systems.

2.1.4 Reinforcement Fabrics

2.1.4.1 Cotton Fabrics

Cotton fabrics shall be woven entirely of cotton conforming with ASTM D 173, thoroughly and uniformly saturated with asphalt.

2.1.4.2 Woven Burlap Fabrics

Woven burlap fabrics shall be composed of 100 percent jute fiber and two cotton threads at each selvage conforming with ASTM D 1327, thoroughly and uniformly saturated with asphalt. The fabric mesh shall not be completely closed or sealed by the process of saturation. Sufficient porosity shall be maintained to allow successive moppings of the plying asphalt to seep through. The surface shall not be coated or covered with talc or any other substances that will interfere with the adhesion between fabric and plying asphalt. The fabric surface shall be uniformly smooth and free of irregularities, folds and knots. The finished woven burlap fabrics shall be free of ragged edges, untrue edges, breaks or cracks, and other visible external defects.

2.1.4.3 Glass Fabrics

Glass fabrics shall conform to ASTM D 1668 Type I, asphalt-treated woven glass waterproofing fabrics coated with asphalt.

2.1.5 Flashing Cement

Flashing cement shall conform to ASTM D 4586, Type I, trowel grade, asbestos free, manufactured from asphalts characterized as adhesive, healing and ductile.

2.2 INSULATION BOARDS

Insulation boards shall conform to ASTM C 208 cellulosic fiber boards, construction grade, 13 mm (1/2 inch) thick, fibrous-felted homogeneous panel. Insulation boards shall be manufactured from ligno-cellulosic fibers (wood or cane) by a felting or molding process, asphalt-saturated or coated, with a density of 49 to 151 kg per square meter (10 to 31 lbs. per square foot). Surfaces of insulation boards shall be free of cracks, lumps, excessive departure from planeness, or other defects that adversely affect performance.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous waterproofing shall be prepared in accordance with waterproofing manufacturer's recommendations. Surface preparation shall be approved prior to waterproofing application.

3.1.1 Protection of Surrounding Areas

Before starting the waterproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work. Drains and conductors shall be protected from clogging with asphalt.

3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry.

3.1.3 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage waterproofing materials shall be repaired. Rough surfaces shall be parged with a well-adhering coat of cement mortar.

3.2 HOT-APPLIED ASPHALT WATERPROOFING

Asphalt waterproofing shall be applied when the ambient temperature is 4 degrees C or above. Heating kettles and tanks shall be provided with automatic thermostatic control capable of maintaining asphalt temperature. Controls shall be calibrated and maintained in working order for duration of work. At time of application, asphalt shall not be heated above the equiviscous temperature (EVT) recommended by manufacturer. Immediately before use, temperature shall be measured with a portable thermometer at the point of application. EVT and flashpoint temperatures of asphalt in kettle shall be conspicuously posted on kettle. Asphalt with a temperature not conforming to the manufacturer's recommendations shall be returned to the kettle. Asphalt overheated by more than 10 degrees C for more than 1 hour shall be removed from site.

3.2.1 Below-Grade Wall Waterproofing

Waterproofing for foundation walls shall consist of a 2-ply hot-applied asphalt membrane system. Fabrics shall be installed using the "shingle" method. Joints shall be caulked prior to primer applications. Primer shall be applied at a rate of 0.2 liters per square meter (1/2 gallon per 100 square feet). Fabrics shall be overlapped at ends and staggered a minimum 480 mm for 2-ply system. End-to-end taping is not acceptable. Each fabric shall be firmly embedded into a solid uniform coating of hot asphalt at a rate of 0.98 kg per square meter (20 lbs. per 100 square feet) by pressing with broom. Fabrics shall not touch fabrics. Hot asphalt shall penetrate each fabric to provide the required adhesion. Asphalt between fabrics shall not be excessive to prevent slippage. Waterproofing system consisting of two or more fabrics shall be provided with fabric reinforcement at corners, angles, over construction joints, and in locations where waterproofing fabrics are subject to unusual stress.

3.3 NOT USED

3.4 CLEAN-UP

Surfaces of other work which are stained with waterproofing materials shall be cleaned with a cleaner recommended by waterproofing manufacturer.

3.5 PROTECTION OF COMPLETED WORK

3.5.1 NOT USED

3.5.2 Wall Waterproofing

Waterproofing against which backfill is to be placed shall be protected with a single layer of insulation board. Insulation boards shall be pressed into the final mopping while the asphalt is still hot, with edges of boards placed into moderate contact and joints staggered. For two-layer installation, joints in second layer shall be staggered over joints in first layer. Where surfaced insulation board is used, the surfaced side shall face outward. Boards shall be carefully and neatly fitted around projections, and shall cover the entire surface of the waterproofing materials. Waterproofing system not covered with protection board shall be protected to prevent damage from subsequent building operations. Installed boards shall not remain exposed at the end of a work day.

-- End of Section --

SECTION 07190

WATER REPELLENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501	(1994) Exterior Walls

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 259	(1980) Resistance of Concrete to Chloride Ion Penetration
AASHTO T 260	(1995) Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 140	(1998; Rev. B) Sampling and Testing Concrete Masonry Units
ASTM C 672	(1992) Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
ASTM D 2369	(1998) Volatile Content of Coatings
ASTM D 3278	(1996) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 514	(1990; R 1996) Water Penetration and Leakage Through Masonry
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Water repellents; G, RE

SD-06 Test Reports

Water absorption; G, RE

Accelerated weathering; G, RE

Resistance to chloride ion penetration; G, RE

Moisture vapor transmission; G, RE

Scaling resistance; ; G, RE

Water Penetration and Leakage; G, RE

SD-07 Certificates

Manufacturer's qualifications; G, RE

Applicator's qualifications; G, RE

Evidence of acceptable variation; G, RE

Warranty; G, RE

SD-08 Manufacturer's Instructions

Application instructions; G, RE

Provide manufacturer's instructions including preparation, application, recommended equipment to be used, safety measures, and protection of completed application.

Manufacturer's material safety data sheets

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

a. Manufacturer's qualifications: Minimum five years record of successful in-service experience of water repellent treatments manufactured for concrete masonry application.

b. Applicator's qualifications: Minimum five years successful experience in projects of similar scope using specified or similar treatment materials and manufacturer's approval for application.

1.3.2 Performance Requirements

a. Water absorption: ASTM C 140. Comparison of treated and untreated specimens.

b. Moisture vapor transmission: ASTM E 96. Comparison of treated and untreated specimens.

c. Water penetration and leakage through masonry: ASTM E 514.

1.3.3 Evidence of Acceptable Variation

If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the Contracting Officer, evidence that the proposed product is either equal to or better than the product specified. Include the following:

a. Identification of the proposed substitution;

b. Reason why the substitution is necessary;

c. A comparative analysis of the specified product and the proposed substitution, including tabulations of the composition of pigment and vehicle;

d. The difference between the specified product and the proposed substitution; and

e. Other information necessary for an accurate comparison of the proposed substitution and the specified product.

1.4 SAMPLE TEST PANEL

The approved Sample Test Panel will serve as the standard of quality for all other water repellent coating work. Do not proceed with application until the sample panel has been approved by the Contracting Officer.

1.4.1 Sample Test Panel

Prior to commencing work, including bulk purchase and delivery of material, apply water repellent treatment to a minimum 1200 mm high by 1200 mm long concrete masonry, test-panel specified in Section 03413, 04200. Provide a full height expansion joint at mid-panel length. Prepare and seal joint with materials approved for project use.

1.4.1.1 Testing

AAMA 501 Provide field water testing of water repellent treated surfaces in the presence of the Contracting Officer and the water repellent treatment manufacturer's representative.

a. Apply water repellent to left side of mock-up and allow to cure prior to application of treatment to right side.

b. Twenty days after completion of application of treatment, test mock-up with 16 mm garden hose, with spray nozzle, located 3 meters from wall and aimed upward so water strikes wall at 45 degree downward angle. After water has run continuously for three hours observe back side of mock-up for water penetration and leakage. If leakage is detected make changes as needed and retest.

c. Coordinate testing procedures and modify project treatment application as required to pass mock-up tests for water penetration and leakage resistance.

1.4.1.2 Approval

Proceed with water repellent treatment work only after completion of field test application and approval of mock-up and tests by the Contracting Officer.

1.4.2 Pre-Installation Meeting

a. Attend pre-installation meeting required prior to commencement of concrete masonry, installation.

b. Review procedures and coordination required between water repellent treatment work and work of other trades which could affect work to be performed under this section of the work.

c. Convene additional pre-installation meeting prior to water repellent treatment application for coordination with work not previously coordinated including joint sealants.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

Notify the Contracting Officer of any water repellent coating specified herein which fails to conform to the local Air Quality Management District Rules at the location of the Project. In localities where the specified coating is prohibited, the Contracting Officer may direct the substitution of an acceptable coating.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original sealed containers, clearly marked with the manufacturer's name, brand name, type of material, batch number, percent solids by weight and volume, and date of manufacturer. Store materials off the ground, in a dry area where the temperature will be not less 10 degrees C nor more than 29 degrees C.

1.7 SAFETY METHODS

Apply coating materials using safety methods and equipment in accordance with the following:

1.7.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The coating manufacturer when using solvents or other chemicals. Use impermeable gloves, chemical goggles or face shield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general public.

b. 29 CFR 1910.1000.

c. Threshold Limit Values (R) of the American Conference of Governmental Industrial Hygienists.

d. Manufacturer's material safety data sheets.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Weather and Substrate Conditions

Do not proceed with application of water repellents under any of the following conditions, except with written recommendations of manufacturer.

a. Ambient temperature is less than 4 degrees C.

b. Substrate faces have cured less than one month.

c. Rain or temperature below 4 degrees C are predicted for a period of 24 hours before or after treatment.

d. Earlier than three days after surfaces are wet.

e. Substrate is frozen or surface temperature is less than 4 degrees C and falling.

1.8.2 Moisture Condition

Determine moisture content of substrate meets manufacturer's requirements prior to application of water repellent material.

1.9 SEQUENCING AND SCHEDULING

1.9.1 Masonry Surfaces

Do not start water repellent coating until all joint tooling, pointing and masonry cleaning operations have been completed. Allow masonry to cure for at least 60 days under normal weather conditions before applying water repellent.

1.9.2 NOT USED

1.9.3 NOT USED

1.9.4 Sealants

Do not apply water repellents until the sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured.

a. Water repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

b. Provide manufacturers' test results of compatibility.

1.10 INSPECTIONS

Notify the manufacturer's representative a minimum of 72 hours prior to scheduled application of water repellents for field inspection. Inspect surfaces and obtain approval in writing from the manufacturer's representative prior to any application of any water repellent coating.

1.11 SURFACES TO BE COATED

Coat all exterior masonry surfaces. This includes back faces of parapets, top of walls, edges and returns adjacent to windows and door frames and free standing walls.

1.12 WARRANTY

Provide a warranty, issued jointly by the manufacturer and the applicator of the water repellent treatment against moisture penetration through the treated structurally sound surface for a period of five years. Warranty to provide the material, labor, and equipment necessary to remedy the problem. At the satisfactory completion of the work, complete the warranty sign, notarize, and submit to the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

Water repellent solution shall be a clear, non-yellowing, deep-penetrating, VOC compliant solution. Material shall not stain or discolor and shall produce a mechanical and chemical interlocking bond with the substrate to the depth of the penetration.

2.2 WATER REPELLENTS

2.2.1 NOT USED

2.2.2 NOT USED

2.2.3 NOT USED

2.2.4 Siloxanes

Penetrating water repellent. Alkoxysiloxanes that are oligomerous with alcohol, ethanol, mineral spirits, or water.

a. Solids by weight: ASTM D 2369, 7.5-16.0 percent.

b. Volatile Organic Content (VOC) after blending: Less than 200 grams per liter.

c. Density, activated: One kilogram per liter, plus or minus one percent.

d. Flash point, ASTM D 3278: Greater than 100 degrees C.

2.3 PERFORMANCE CRITERIA

2.3.1 NOT USED

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 Siloxanes

a. Dry time for recoat, if necessary: One to two hours depending on weather conditions.

b. Penetration: 10 mm, depending on substrate.

c. Water penetration and leakage through masonry, ASTM E 514, percentage reduction of leakage: 97.0 percent minimum

d. Moisture vapor transmission, ASTM E 96: 47.5 perms or 82 percent maximum compared to untreated sample.

e. Resistance to accelerated weathering, ASTM G 53. Testing 2,500 hours: No loss in repellency.

f. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.

g. Scaling resistance,ASTM C 672, non-air-entrained concrete: Zero rating, no scaling, 100 cycles treated concrete.

PART 3 EXECUTION

3.1 EXAMINATION

Examine masonry surfaces to be treated to ensure that:

a. All visible cracks, voids or holes have been repaired.

b. All mortar joints in masonry are tight and sound, have not been re-set or misaligned and show no cracks or spalling.

c. Moisture contents of walls does not exceed 15 percent when measured on an electronic moisture register, calibrated for the appropriate substrate.

d. Concrete surfaces are free of form release agents, curing compounds and other compounds that would prevent full penetration of the water repellent material.

Do not start water repellent treatment work until all deficiencies have been corrected, examined and found acceptable to the Contracting Officer and the water repellent treatment manufacturer. Do not apply treatment to damp, dirty, dusty or otherwise unsuitable surfaces. Comply with the manufacturer's recommendations for suitability of surface.

3.2 PREPARATION

3.2.1 Surface Preparation

Prepare substrates in accordance with water repellent treatment manufacturer's recommendation. Clean surfaces of dust, dirt, efflorescence, alkaline, and foreign matter detrimental to proper application of water repellent treatment.

3.2.2 Protection

Provide masking or protective covering for materials which could be damaged by water repellent treatment.

a. Protect glass, glazed products, and prefinished products from contact with water repellent treatment.

b. Protect landscape materials with breathing type drop cloths: plastic covers are not acceptable.

3.2.3 Compatibility

a. Confirm treatment compatibility with each type of joint sealer within or adjacent to surfaces receiving water repellent treatment in accordance with manufacturer's recommendations.

b. When recommended by joint sealer manufacturer, apply treatment after application and cure of joint sealers. Coordinate treatment with joint sealers.

c. Mask surfaces indicated to receive joint sealers which would be adversely affected by water repellent treatment where treatment must be applied prior to application of joint sealers.

3.3 MIXING

Mix water repellent material thoroughly in accordance with the manufacturer's recommendations. Mix, in quantities required for that days work, all containers prior to application. Mix each container the same length of time.

3.4 APPLICATION

In strict accordance with the manufacturers written requirements. Do not start application without the manufacturer's representative being present or his written acceptance of the surface to be treated.

3.4.1 Water Repellent Treatment

3.4.1.1 Spray Application

Spray apply water repellent material to exterior masonry surfaces using low-pressure airless spray equipment in strict accordance with manufacturer's printed application, instructions, and precautions. Maintain copies at the job site. Apply flood coat in an overlapping pattern allowing approximately 200 to 250 mm rundown on the vertical surface. Maintain a wet edge at all overlaps, both vertical and horizontal. Hold gun maximum 450 mm from wall.

3.4.1.2 Brush or Roller Application

Brush or roller apply water repellent material only at locations where overspray would affect adjacent materials and where not practical for spray applications.

3.4.1.3 Covered Surfaces

Coat all exterior masonry surfaces including back faces of parapets, tops of walls, edges and returns adjacent to window and door frames, window sills, and free-standing walls.

3.4.1.4 Rate of Application

Apply materials to exterior surfaces at the coverages recommended by the manufacturer and as determined from sample panel test. Increase or decrease application rates depending upon the surface texture and porosity of the substrate so as to achieve even appearance and total water repellency.

3.4.1.5 Number of Coats

The sample panel test shall determine the number of coats required to achieve full coverage and protection.

3.4.1.6 Appearance

If unevenness in appearance, lines of work termination or scaffold lines exist, or detectable changes from the approved sample panel occur, the Contracting Officer may require additional treatment at no additional cost to the Government. Apply any required additional treatment to a natural break off point.

3.5 CLEANING

Clean all runs, drips, and overspray from adjacent surfaces while the water

repellent treatment is still wet in a manner recommended by the manufacturer.

3.6 FIELD QUALITY CONTROL

Do not remove drums containing water repellent material from the job site until completion of all water repellent treatment and until so authorized by the Contracting Officer.

3.6.1 Field Testing

AAMA 501. At a time not less than twenty days after completion of the water repellent coating application, subject a representative wall area of the building to the Hose Stream Field Test similiar to AAMA 501 hose test to simulated rainfall for a period of three hours. Use a minimum 16 mm diameter hose and a fixed lawn sprinkler spray head which will direct a full flow of water against the wall. Place the sprinkler head so that the water will strike the wall downward at a 45 degree angle to the wall. If the inside of the wall shows any trace of moisture during or following the test, apply another coat of water repellent, at the manufacturer's recommended coverage rate to the entire building. Repeat testing and re-coating process until no moisture shows on the inside wall face. Accomplish any required work retesting and re-coating at no additional cost to the Government.

3.6.2 Site Inspection

Inspect treatment in progress by manufacturer's representative to verify compliance with manufacturer instructions and recommendations.

-- End of Section --

SECTION 07220A

ROOF INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4897	(1998) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513	(1996) Loss Prevention Data for Roofing Contractors
FM P7825a	(1998) Approval Guide Fire Protection
FM P7825c	(1998) Approval Guide Building Materials

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1999) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Application of Insulation; G, RE

Insulation manufacturer's recommendations for the application and installation of insulation.

Inspection; G, RE

The inspection procedure for insulation installation, prior to start of roof insulation work.

SD-07 Certificates

Insulation; G, RE
Organic Roofing Felt; G, RE

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material. Certificates of compliance for felt materials.

1.3 STORAGE OF MATERIALS

Insulation materials shall be stored in accordance with manufacturer's instructions. Insulation, base sheet, and felt shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation, wet base sheet or wet felt shall be permanently removed from the site. Felts shall be stacked on end one level high. Felt rolls shall be maintained at a temperature above 10 degrees C for 24 hours immediately before laying.

1.4 FIRE CLASSIFICATION

Insulation shall have been tested as part of a roof construction assembly of the type used in this project, and the construction shall be listed as Fire-Classified in UL Bld Mat Dir or Class I in FM P7825a.

PART 2 PRODUCTS

2.1 NOT USED

2.2 INSULATION

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 24 degrees C, and the thickness. Minimum thickness shall be as recommended by the manufacturer. Boards shall be marked individually. The thermal resistance of insulation shall be not less than the R-value shown on the drawings. The insulation manufacturing process shall not include chlorofluoro carbons (CFC) or formaldehydes. Insulation shall be the following material:

2.2.1 NOT USED

2.2.2 NOT USED

2.2.3 NOT USED

2.2.4 NOT USED

2.2.5 NOT USED

2.2.6 Polyisocyanurate

ASTM C 1289, Type I, or ASTM C 1289 Type II, having minimum recovered material content of 9 percent by weight of the polyisocyanurate portion of the board.

2.3 FASTENERS

Fasteners shall be specifically designed screws and plates or spikes and plates of sufficient length to hold insulation securely in place. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 534 N each in steel deck. Fasteners for steel or concrete decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 4.3 kPa.

2.4 VENTING INORGANIC BASE SHEET

ASTM D 4897, Type II, Non-perforated, with spot mopping holes where specified.

2.5 NOT USED

2.6 ORGANIC ROOFING FELT

ASTM D 226, Type I.

2.7 WOOD NAILERS

Wood nailers shall conform to Section 06100 ROUGH CARPENTRY, including preservative treatment. Edge nailers shall be not less than nominal 150 mm wide and of thickness to finish flush with the top surface of the insulation. Surface mounted nailers shall be a nominal 75 mm wide by the full thickness of the insulation.

PART 3 EXECUTION

3.1 COORDINATION REQUIREMENTS

Insulation and roofing membrane shall be finished in one operation up to the line of termination at the end of each day's work. Completed sections shall be glaze coated when more than one day is required to finish the roofing. Phased construction will not be permitted.

3.2 ENVIRONMENTAL CONDITIONS

The temperature of the roofing materials shall be as required by the manufacturer. Air temperature shall be above 4 Degrees C and there shall be no visible ice, frost, or moisture on the roof deck when the insulation and roofing are installed. Wind conditions shall be suitable for installation of insulation: Wind chill may affect the proper application temperatures of materials; hot materials may be blown about, creating

safety dangers; insulation boards may become difficult and hazardous to handle; wrappers, coverings, and other debris may become airborne, and possibly contaminate laps and seams.

3.3 SUBSTRATE PREPARATION

The substrate construction of any bay or section of the building shall be completed before insulation or vapor retarder work is begun thereon. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Prior to application of vapor retarder or insulation, substrate joints shall be covered with a 100 mm strip of roofing felt, embedded in and coated with asphalt cement. Substrate surface shall be smooth, clean, and dry at time of application.

3.4 NOT USED

3.5 NOT USED

3.6 INSTALLATION OF WOOD NAILERS

Nailers shall be secured to cast-in-place deck materials by not less than 9 mm diameter anchors embedded in the deck not over 1.2 meters on centers. Nailers shall be secured to precast deck materials and to steel decks as indicated. Bolt anchors shall have nuts and washers countersunk, and bolts shall be cut flush with top of nailer. Powder-actuated fasteners, sized and spaced for nailer anchorage equivalent to that specified and indicated, may be used when approved. Surface mounted nailers shall be installed parallel with the roof slope and shall be spaced not over 1.2 meters face-to-face, except that where the insulation units are less than 1.2 meters in length the nailers shall be spaced to minimize cutting of the insulation. On sloped roofs exceeding 62.5 mm per meter for modified bituminous systems and 83 mm per meter for BUR systems, nailers shall be installed in accordance with the recommendations of the membrane system manufacturer.

3.7 APPLICATION OF INSULATION

Insulation shall be laid in two or more layers. Units of insulation shall be laid in courses parallel with the roof slope. End joints shall be staggered. Insulation shall be cut to fit neatly against adjoining surfaces. Joints between insulation boards shall not exceed 6 mm . Joints in successive layers shall be staggered with respect to joints of preceding layer. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

3.7.1 Mechanical Fastening

On steel decks, for any slope exceeding 42 mm/m, multiple layers of insulation shall be mechanically fastened. Method of attachment shall be

in accordance with recommendations of the insulation manufacturer and requirements specified.

3.7.2 Steel Decks

All steel decks shall be insulated before receiving a roof membrane. Uninsulated steel decks shall have insulation applied to span the steel deck flutes and to act as an underlayment for the roof membrane. First layer of insulation on steel deck shall be compatible with mechanical fastening and shall meet fire resistant requirements.

3.7.3 NOT USED

3.7.4 Installation

Insulation shall be installed as indicated and in accordance with manufacturer's instructions. Rigid insulation board shall be laid in close contact. If more than one layer of insulation is required, joints of second layer shall be offset from the first layer. Rigid insulation shall be attached to the metal deck with bearing plates and fasteners, as recommended by the insulation manufacturer, so that insulation joints are held tight against each other, with no less than 1 fastener and bearing plate per 0.37 square meter (4 fasteners and bearing plates per square yard) of insulation. Joints shall be tight and sealed. Layout and joint pattern of insulation shall be indicated on the shop drawings.

3.7.5 Protection Requirements

The insulation shall be kept dry at all times. Insulation boards shall not be kicked into position. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement. Cutoffs shall be removed when work is resumed. Edges of insulation at open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, shall be protected until permanent roofing and flashing is applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces will not be permitted. Smooth, clean board or plank walkways, runways, and platforms shall be used, as necessary to distribute weight to conform to indicated live load limits of roof construction.

3.8 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM P9513.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.

e. Inspection of mechanical fasteners; type, number, length, and spacing.

f. Coordination with other materials, cants, sleepers, and nailing strips.

g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

h. Installation of cutoffs and proper joining of work on subsequent days.

i. Continuation of complete roofing system installation to cover insulation installed same day.

-- End of Section --

SECTION 07410N

METAL WALL PANELS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM D 522	(1993; Rev. A) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1994) Specular Gloss
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1997) Water Resistance of Coatings in 100 Percent Relative Humidity
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E 1592	(1995) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993) Architectural Sheet Metal Manual

1.2 DEFINITIONS

1.2.1 Corrugated Sheet

Metal sheet with finish coating system which is bent into standard corrugated shapes by roll-forming.

1.2.2 Finish Coating System

Factory-applied, organic coating system which is applied over sheet.

1.2.3 Flat Metal Sheet

Relatively thin, rectangular in cross-section and form, protected from corrosion by metallic coating bonded to base metal (with exception of aluminum alloy 3004), produced in commercial sizes, and usually furnished in coiled lengths for further processing.

1.2.4 Panel

One of series of standard-sized units produced by factory cutting of longer lengths of corrugated sheet, ready for installation as preformed metal roofing or siding.

1.2.5 Edge Creepage

Measurement of expected performance at conditions of field cut panel edges, drilled hole edges or site scratches of protective coating through handling or tool misusage.

1.2.6 Preformed

Roll formed, in the field or factory, to the manufacturer's approved configuration prior to installation.

1.2.7 System

The composite assembly of all components of the roof or wall system; including insulation, flashings, fasteners, other accessories, sealants, and transitions at roof and/or wall penetrating elements; necessary for a

watertight installation.

1.3 PERFORMANCE REQUIREMENT

1.3.1 Deflection

When subjected to full design loads, aluminum wall panels shall not deflect more than 1/60 of panels' clear span.

1.3.2 Wind Uplift

The structural performance test methods and requirements of the roof and wall systems and attachments shall be in accordance with ASTM E 1592.

Wall systems and attachments shall resist the following wind loads as determined by ASCE 7 in kilograms per square meter, with a factor of safety appropriate for the material holding the anchor:

Walls

a. At building corners	626 kg/m^2	135 kg/m^2
b. At central areas	372 kg/m^2	135 kg/m^2

1.3.3 Formability Test

In accordance with ASTM D 522, finish coating system shall show no microchecking of exterior film with no loss of adhesion, when subjected to 180-degree bend over 3 mm diameter mandrel and 10 mm diameter mandrel for coatings 0.10 mm or thicker.

1.3.4 Weathering Test

Sample of finished-coated sheet shall withstand weathering test for minimum of 2,000 hours in accordance with ASTM G 23 or ASTM G 26 without cracking, peeling, blistering, loss of adhesion of finish coating system or corrosion of base metal. Finish coating system that can be readily removed from base metal with penknife blade or similar instrument shall be considered to indicate loss of adhesion.

1.3.5 Chalking Resistance

After 2,000-hour weathering test, finish coating system shall not chalk less than No. 8 rating when measured in accordance with ASTM D 4214test procedures.

1.3.6 Color Change

After 2,000-hour weathering test, color change of finish coating system shall not exceed 5 NBS units when measured in accordance with ASTM D 2244 test procedures.

1.3.7 Specular Gloss

Finished surface shall have specular gloss value of 30 to 70 at angle of 60 degrees when measured in accordance with ASTM D 523.

1.3.8 Salt Spray Test

Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, coating shall receive a rating of 10, no blisters in field as determined by ASTM D 714; and an average rating of 7, 2 mm failure at scribe, as determined by ASTM D 1654. Rating Schedule No. 1.

1.3.9 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, coating system shall withstand minimum of 50 liters of sand per mil of coating thickness before appearance of base metal.

1.3.10 Humidity Test

When subjected to humidity cabinet test in accordance with ASTM D 2247 for 1,000 hours, factory-finished, organic-coated panel shall show no signs of blistering, cracking, creepage, or corrosion with no loss of adhesion.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Panels; G, RE

Fasteners; G, RE

Supports; G, RE

Flashing; G, RE

Closures; G, RE

In addition to the manufacturer's printed installation instruction manual and standard details, submit drawings to supplement the instructions and details. Drawings shall be thorough and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation shall be in accordance with the manufacturer's standard instructions and details or the SMACNA Arch. Manual. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

SD-03 Product Data

Panels; G, RE

Accessories; G, RE

Fasteners; G, RE

Sample warranty certificate; G, RE

Submit catalog cuts, technical data sheets, and descriptive literature.

SD-04 Samples

Panels; G, RE

Submit one sample of each color indicated. When colors are not indicated, submit minimum six different samples of manufacturer's standard colors for selection.

SD-06 Test Reports

Formability test; G, RE

Weathering test; G, RE

Chalking resistance; G, RE

Color change; G, RE

Specular gloss; G, RE

Salt spray test; G, RE

Abrasion resistance test; G, RE

Humidity test; G, RE

Wind uplift; G, RE

Submit reports performed by independent qualified testing laboratories.

SD-07 Certificates

Qualification of installer; G, RE

Certify that the installer meets requirements specified under paragraph entitled "Qualification of Installer," and include the roofing system manufacturer's written approval of the installer.

Coil Stock

Submit certification from coil stock manufacturer or supplier that the machinery used will form the provided coil stock without warping, waviness, or rippling that is not a part of the panel profile, and without damage, abrasion or marring of the finish coating.

1.5 QUALITY ASSURANCE

1.5.1 NOT USED

1.5.2 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place.

The representative shall be available to perform field inspections and attend meetings as required herein and as requested by the Contracting Officer.

1.6 DELIVERY, STORAGE, AND HANDLING

Carefully deliver, store, and handle panels and other manufactured products. Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering. Do not use plastic which may cause sweating or condensation. Store panels so that water which may have accumulated during transit or storage, drains off. Do not store panels in contact with materials that might cause staining. Inspect panels upon arrival at jobsite; if wet, remove moisture, and restack and protect panels until used.

1.7 Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal wall panels. The warranty period shall be not less than 5 years from the date of Government acceptance of the work. The warranty shall be issued directly to the Government. The warranty shall provide that if within the warranty period the metal wall panels become non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panels resulting from defective materials or workmanship the repair or replacement of the defective materials and correction of the defective workmanship shall be the responsibility of the metal wall panel manufacturer. Repairs that become necessary because of defective materials and workmanship while wall panels are under warranty shall be performed within 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer.

PART 2 PRODUCTS

2.1 SIDING PANELS

Wall panels shall be aluminum and shall have a factory color finish meeting the specified requirements. Wall panels shall have interlocking ribs for securing adjacent sheets. Wall covering shall be fastened to framework using concealed fasteners. Length of sheets shall be sufficient to cover the entire height of any unbroken wall surface when such dimension is 9140 millimeters, or less. Sheets may be longer than 9140 millimeters if approved by the Contracting Officer. Design provisions shall be made for expansion and contraction. Thickness of sheet for panels shall be not less than specified. Where gages are specified, gages are subject to normal manufacturing tolerances.

2.1.1 NOT USED

2.1.2 Coated Aluminum Alloy Panels

2.1.2.1 NOT USED

2.1.2.2 Material and Coating

Form sheets of Alloy 3004 or Alclad 3004 conforming to ASTM B 209M having proper temper to suit respective forming operations.

2.1.2.3 Thickness

Minimum 0.84 mm nominal for wall panels, but in no case thinner than that required to meet maximum deflection requirements specified.

2.1.2.4 Factory Color Finish

Panels shall have a factory applied polyvinylidene fluoride finish of 0.8 +/- 0.05 mil on both sides. The exterior finish shall consist of a 0.8 +/- 0.05 mil 70 percent Hylar 5000 or 70 percent Kynar 500 color and a 0.8 +/- 0.05 mil 70 percent Hylar 5000 or 70 percent Kynar 500 clear top coat. The exterior color finish shall meet the test requirements specified below. Color shall be as indicated in Specification Section 09915R.

2.1.3 NOT USED

2.1.4 Accessories

Provide sheet metal flashings, trim moldings, closure strips, caps, and other preformed metal panel accessories, of same material and finish as panels, except accessories that are concealed after installation, and are aluminum or zinc-coated steel may be provided unfinished. Provide metal thickness not less than that of panels. Provide molded closure strips of closed-cell or solid-cell synthetic rubber, neoprene, or polyvinyl chloride premolded to match configurations of preformed metal panels.

2.1.5 Fasteners

Provide fasteners for attaching panels to structural supports and to adjoining panels as approved and in accordance with printed manufacturer's recommendations; unless specified otherwise, fasteners shall be any of the following: self-tapping screws, bolts and nuts and self-locking rivets,

self-locking bolts, end-welded studs, bolted or riveted studs, and stem rivets held by aluminum straps. Provide fastening system to withstand design loads indicated. Fasteners shall be Series 305 stainless steel for aluminum panels. Fasteners, except those having integral hexagonal washer heads and those having aluminum drive caps, shall have composite metal and neoprene washers. Provide fasteners having integral hexagonal washer heads and fasteners having aluminum drive caps with polychloroprene washers. Heads of screws or bolts exposed on exterior face of factory-finished wall shall be nylon headed to match color of wall.

2.1.5.1 Screws

Not less than 6 mm diameter self-tapping type or self-drilling and self-tapping type.

2.1.5.2 Stud Welding

Provide shouldered type studs with minimum shank diameter of 4.76 mm and with cap or nut for holding preformed metal panels against shoulder.

2.1.5.3 Powder-Actuated Fasteners

Provide type to be fastened with powder-actuated tools and with shank diameter of adequate size to support loads imposed. Provide 13 mm minimum shank length for fastening panels to steel and 25 mm for fastening panels to concrete. Provide fasteners for securing wall panels with threaded studs suitable for attaching approved color-coated nuts or caps.

2.1.5.4 Blind Rivets

Stainless steel with nominal 5 mm diameter shank or aluminum with nominal 5 mm diameter shank. Provide thread-stem-type rivets for other than fastening of trim. Close rivets with hollow stems.

2.1.5.5 Bolts

Minimum 6 mm diameter, shouldered or plain shank nuts.

2.1.6 Joint-Sealing Material

Compressible adhesive-cohesive butyl polyisobutylene rubber tape.

PART 3 EXECUTION

3.1 INSTALLATION

In accordance with manufacturer's approved installation instructions, and approved drawings, except as specified otherwise. Install panels in full and firm contact with each other at side and end laps. Where panels are cut in field or where factory-applied coating is damaged and necessary repairs have been made with material of same type and color as finish coating, obtain approval of the Contracting Officer before installation. Correct defects in materials. Remove defective materials which cannot be corrected, and provide non-defective materials. Provide molded closure

strips where indicated and whenever panels terminate with open ends after installation.

3.1.1 Wall Panels

Apply panels with longitudinal configurations in vertical position. Provide panels in full wall heights from base to eave with no horizontal joints except at junctions of door frames, window frames, louver panels, and similar locations. Seal side and end laps with joint-sealing material. Flash seal walls at base and at top, around windows, door frames, framed louvers, and other similar openings. Place closures, flashing, and sealing materials to achieve complete water tightness. Flashing is not required where approved interlocking, concealed-type side joints with concealed fasteners for wall panels are used. Minimum end laps for panels shall be 100 mm and shall occur only over girt and structural members. Side laps shall be standard overlap or interlocking ribs based on manufacturer's standard.

3.1.2 NOT USED

3.1.3 Flashings

Provide flashings, related closures, and accessories provided with preformed metal panels where indicated to provide watertight installation. Install flashing, related closure, and accessories not indicated in accordance with panel manufacturer's printed instructions and details or approved shop drawings. Installation shall allow for expansion and contraction of flashing.

3.1.4 Fastener Installation

Provide fastener spacings in accordance with manufacturer's recommendations to withstand design loads indicated. Install fasteners in valleys or crowns in accordance with manufacturer's recommendations. Install fasteners in straight lines within tolerance of 13 mm in length of bay. Drive exposed, penetrating-type fasteners normal to surface and to uniform depth to seat washers with gaskets. Drive so as not to damage factory-applied coating. Provide thermal space blocks at each fastener to provide thermal barrier and to eliminate condensation. Exercise extreme care when drilling pilot hole for fastenings to keep drills perpendicular and centered in valleys or crowns, as applicable. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used when applying fasteners shall not exceed that recommended by manufacturer. Remove panels damaged by over-torqued fastenings, and provide new panels. Remove metal shavings and fillings from roofs upon completion to prevent rusting and discoloration of panels.

3.2 NOT USED

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool,

fittings and drilling debris and scrub the work clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

-- End of Section --

SECTION 07412

STANDING SEAM METAL ROOFING SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(1999a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1999) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1999) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1999) Specular Gloss
ASTM D 610	(1995) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(1987; R 1994el) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1998) Effect of Household Chemicals on Clear and Pigmented Organic

	Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1997) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 4587	(1991) Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water- Exposure Apparatus
ASTM D 5894	(1996) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Roofing; G, RE

a. Drawings consisting of catalog cuts, flashing details, erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be provided by the metal roofing manufacturer.

b. Drawings showing the UL 580, Class 90 tested roof system assembly.

SD-04 Samples

Accessories; G, RE

One sample of each type of flashing, trim, fascia, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels; G, RE

One piece of each type and finish to be used, 225 mm long, full width.

Fasteners; G, RE

Two samples of each type to be used with statement regarding intended use. If so requested, random samples of screws, bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Gaskets and Insulating Compounds; G, RE

Two samples of each type to be used and descriptive data.

Sealant; G, RE

One sample, approximately 0.5 kg, and descriptive data.

SD-07 Certificates

Roof Panels; G, RE
Installation; G, RE
Accessories; G, RE

Certificates attesting that the panels and accessories conform to the specified requirements. Certificate for the roof assembly shall certify that the assembly complies with the material and fabrication requirements specified and is suitable for the installation at the indicated design slope. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that at least 3

representative samples of similar material to that which will be provided on this project have been previously tested and have met the quality standards specified for factory color finish.

Insulation; G, RE

Certificate attesting that the polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Installer; G, RE

Certification of installer.

Warranties; G, RE

At the completion of the project, signed copies of the 5-year Warranty for Standing Seam Metal Roofing System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material and Weathertightness Warranties shall be given to the Contracting Officer.

1.3 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies the specified design and additional requirements contained herein. The roofing system shall be provided by the Contractor as a complete system, as tested and approved in accordance with UL 580. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

1.3.1 Standing Seam Metal Roof System

The Standing Seam Metal Roof System covered under this specification shall include the entire roofing system; the metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. The system shall be installed on a substrate as shown on drawings. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts, eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the system.

1.3.2 Manufacturer

The SSMRS shall be the product of a manufacturer who has been in the practice of manufacturing metal roofs for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

If the installer is not employed by the manufacturer, a technical representative of the SSMRS manufacturer shall be present on site to approve the mockup panel and at the beginning of the roof installation and for a minimum of four (4) days thereafter. The representative shall have a minimum of 5 years experience with the same manufacturer and type of system being installed. The representative shall verify that the roof is being installed in accordance with the manufacturer's approved standards. The representative shall inspect the roof at the completion of the work and verify in writing to the Contracting Officer that the entire installation meets the manufacturer's approved requirements for a full premium 20-year weathertightness warranty. The technical representative shall immediately bring to the attention of the Contracting Officer any work that is not in compliance with the manufacturer's requirements. Corrective action shall be taken by the installer to bring installation into full compliance with the manufacturer's requirements. The technical representative shall sign the form at the end of this section and turn it in to the Contracting Officer on the completion of the roofing work.

1.3.2.1 Quality Assurance Submittals

a. Manufacturer's Instructions: Manufacturer's installation instructions that comply with warranty requirements.

b. Manufacturer must provide a letter stating that they will provide a technical inspection within five days of start of project and again at substantial completion.

1.3.3 Installer

The installer shall be certified by the SSMRS manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished.

The installer may be either employed by the manufacturer or be an independent installer trained and approved by the manufacturer. The installer shall be a member of the National Roofing Contractor's Association (NRCA). The installer shall sign the form at the end of this section stating that plans and specifications have been thoroughly reviewed and the roof as designed qualifies for the manufacturer's premium 20-year weathertightness warranty and provide a letter from the manufacturer supporting this claim.

1.4 DESIGN LOADS

Standing Seam Metal Roof System assemblies shall be tested as defined in UL 580 Construction No. 238A, 336, 345A, or 354A, and shall be capable of resisting the wind uplift pressures shown on the contract drawings or, as a minimum, shall be approved to resist wind uplift pressures of UL 580, Class 90.

1.4.1 Thermal Loads

Roof panels shall be free to move in response to the expansion and

contraction forces resulting from a total temperature range of 65 deg. C during the life of the structure.

1.5 PERFORMANCE REQUIREMENTS

The metal roofing system supplied shall conform to the roof slope, the underlayment, and uplift pressures shown on the contract drawings. The Contractor shall furnish a commercially available roofing system which satisfies all the specified requirements.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weather tight coverings and kept dry. Material shall not be covered with plastic where such covering will allow sweating and condensation. Plastic may be used as tenting with air circulation allowed. Storage conditions shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The Standing Seam Metal Roofing System shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.7.1 Contractor's Weathertightness Warranty

The Standing Seam Metal Roofing System shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The roofing covered under this warranty shall include the entire roofing system, including but not limited to, the roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the roof system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR STANDING SEAM METAL

ROOF SYSTEM, and shall start upon final acceptance of the facility. It is required that the Contractor provide a separate bond in an amount equal to the installed total roofing system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the 5 year Contractor's warranty period for the entire roofing system as outlined above.

1.7.2 Manufacturer's Material Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all Standing Seam Metal Roofing System components such as roof panels, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, fail structurally, or perforate under normal atmospheric conditions at the site. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing or replacing the defective coated coil material.

c. A roofing system manufacturer's 20 year system weathertightness warranty.

d. The manufacturers' 20-year weathertightness warranty shall include all costs of both labor and material to maintain the roof in a weather tight condition and shall include repairs due to improper installation including all flashings up to 300 mm above the finished roof line.

1.8 PRELIMINARY ROOFING CONFERENCE

As soon possible after award of roofing work, meet with Roofing Provider, Roofing Installer), installers of substrate construction (roof decks and structural steel) and other work adjoining roof system including penetrating work and roof accessories, Representative of the Contracting Officer, and representatives of other entities directly concerned with performance of roofing system.

1.8.1 Review Requirements

Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials, and installation facilities and establish preliminary installation schedule. Review requirements for inspections, testing, certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation

procedures.

1.8.2 Roofing System Protection Requirements

Discuss roofing system protection requirements for construction period extending beyond roofing installation. Discuss possible need for temporary roofing.

1.8.3 Record Discussion

Record discussion, including agreement or disagreement on matters of significance, furnish copy of recorded discussions to each participant. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.9 PREAPPLICATION ROOFING CONFERENCE

Approximately 2 weeks before scheduled commencement of roofing installation and associated work, meet at Project site with Installer, installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Representative of the Contracting Officer, roofing system manufacturer's representative, roofing installer, and other representatives directly concerned with performance of the Work.

1.9.1 Review Foreseeable Methods

Review foreseeable methods and procedures related to roofing work, including but not necessarily limited to the following:

a. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations, and other preparatory work performed by other trades.

b. Review structural loading limitations of steel deck and inspect deck for loss of flatness and for required mechanical fastening.

c. Review roofing system requirements (drawings, specifications, and other contract documents).

d. Review required submittals, both completed and yet to be completed.

e. Review and finalize construction schedule related to roofing work, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

f. Review required inspection, testing, certifying, and material usage accounting procedures.

g. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).

1.9.2 Record Contractor Discussions

Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.10 QUALITY ASSURANCE

Installer to be an authorized distributor, trained by the roof system manufacture, and unconditionally acceptable to the rood system manufacturer. Installer must provide a list of five completed projects similar in size and scope with a twenty year manufacturer's weathertightness warranty. Installer must provide phone numbers and POC for owners, architects, and roof system manufacturers.

1.10.1 Sheet Metal Industry

Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Architectural Sheet Metal Manual.

1.10.2 National Roofing Contractors Association

Comply with the National Roofing Contractors Association (NRCA) manual section architectural SSMR details.

1.10.3 Installer

The installer shall install architectural SSMR according to the manufacturer's technical manual, however; the NRCA and SMACNA details for architectural (non-structural) standing seam metal form the minimum acceptable standards. The most stringent shall apply.

1.10.4 Installation Manual

A copy of the manufacturers technical installation manual and 4th edition of the NRCA manual shall be on the job site at all times.

1.10.5 Bonding

The installer must provide a payment and performance bond from a treasury listed bonding company.

1.11 PROJECT CONDITIONS

1.11.1 Field Measurements

Verify actual measurements/openings by field measurements before fabrication: Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

1.12 MOCKUP

Provide mockup of standing seam metal roof system; 2.4 m (8 ft) long by 1.2 m (4 ft) wide, which includes corner condition associated attachments, flashings, joints and junctions, control or expansion joints, terminating item (edge condition at roof edge), fixed eave with gutter, ridge (floating), valley, gable and rake, metal decking and insulation. Include prefab roof curb, and pipe boot flashing.

Locate where directed by the Contracting Officer.

Mockup shall not remain as part of the Work.

PART 2 PRODUCTS

2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 9 m. Sheets longer than 9 m may be furnished if approved by the Contracting Officer. Width of sheets shall provide not less than 300 mm and not more than 450 mm of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. SSMR system with roofing panels greater than 300 mm in width shall have standing seams rolled during installation by an electrically driven seaming machine. Height of standing seams shall be approximately 50 mm but not less than 25 mm. All sheets shall be either square-cut or miter-cut. The ridge cap shall be installed as recommended by the metal roofing manufacturer. Height of corrugations, ribs, or seams, at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

2.1.1 Steel Panels

Zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Uncoated roof panels shall be 22 gage thick minimum. Panels shall be within 95 percent of the nominal thickness. Prior to shipment, mill finish panels shall be treated with a passivating chemical and oiled to inhibit the formation of oxide corrosion products. Panels that have become wet during shipment and have started to oxidize shall be rejected.

2.2 ACCESSORIES

Accessories shall be compatible with the roofing furnished. Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water.

2.2.1 Gutters, Downspouts, and Collector Heads

Gutters, downspouts and collector heads shall be fabricated of zinc coated steel or aluminum zinc alloy coated steel and shall have a size and shape as indicated. All accessories for the complete installation shall be furnished. Accessories shall include gutter brackets, downspout elbows, straps and fasteners. All product surfaces with exterior exposure, (i.e., inside of gutters), shall receive same finish as the exposed surfaces.

2.3 FASTENERS

Fasteners for roof panels shall be zinc-coated steel, type and size as recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the roofing to waterproof the fastener penetration. Washer material shall be compatible with the panels; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 3 mm thick.

2.3.1 Concealed Anchor Clips

Concealed anchor clips shall have factory punched or drilled holes for attachment. There shall be a minimum of two fasteners per clips. clops shall be made to accommodate the total thermal movement required.

2.4 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish of 0.8 +/- 0.05 mil on both sides. The exterior finish shall consist of a 0.8 +/- 0.05 mil 70 percent Hylar 5000 or 70 percent Kynar 500 color and a 0.8 +/- 0.05 mil 70 percent Hylar 5000 or 70 percent Kynar 500 clear top coat. Color shall match the color indicated on the drawings and in Section 09915 COLOR SCHEDULE. The exterior color finish shall meet the test requirements specified below.

2.4.1 Cyclic Salt Fog/UV Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2016 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; 10, no rusting, as determined by ASTM D 610; and a rating of 6, over 1.5 to 3.0 mm failure at scribe, as determined by ASTM D 1654.

2.4.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 3 mm diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

2.4.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested in accordance with ASTM D 4587, test condition D for 2000 total hours. The coating shall withstand the

weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. For sheets required to have a low gloss finish, the chalk rating shall be not less than No. 6 and the color difference shall be not greater than 7 units.

2.4.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.4.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 13 mm diameter hemispherical head indenter, equal to 6.7 times the metal thickness in mm, expressed in N-meters, with no cracking.

2.4.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.4.7 Specular Gloss

Finished roof surfaces shall have a specular gloss value of 25 to 35 at 60 degrees when measured in accordance with ASTM D 523.

2.4.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.4.9 Roof Sheathing

Non-structural, fiberglass-faced, water-resistant gypsum core panel, 16 mm (5/8 in) thick, 1200 mm (4 ft) wide with straight edges. Noncombustible when tested in accordance with ASTM E 136 and UL classified type X when tested in accordance with ASTM E 119. Flame spread I, smoke developed O, when tested in accordance with ASTM E 84.

2.5 UNDERLAYMENTS

2.5.1 Felt Underlayment (Slip Sheet)

Felt underlayment shall be No. 30 felt in accordance with ASTM D 226, Type II.

2.5.2 Rubberized Underlayment

Rubberized underlayment shall be equal to "Ice and Water Shield" as manufactured by Grace Construction Products, "Winterguard" as manufactured by CertainTeed Corporation, or "Weather Watch Ice and Water Barrier" as manufactured by GAF Building Materials Corporation.

2.6 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 24 degrees C in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Insulation, including facings, shall have a flame spread not in excess of 75 and a smoke developed rating not in excess of 150 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

2.6.1 Rigid Board Insulation for Use Above a Roof Deck

2.6.1.1 Polyisocyanurate

Polyisocyanurate insulation shall conform to ASTM C 1289, Type I, Class 2 (having a minimum recovered material content of 9 percent by weight of core material in the polyisocyanurate portion). For impermeable faced polyisocyanurate (Ex: aluminum foil) the maximum design R-value per 25 mm of insulation used shall be 7.

2.6.1.2 Composite Type

Provide 19 mm thick, integrally bonded course of rigid, perlite-or mineral-fiber insulation board to form composite board with polyisocyanurate insulation.

2.6.1.3 Insulation Overlay Board

High-density wood fiberboard, minimum density 15 pcf, 13 mm thick; ASTM C 208 Roof Insulation Board.

2.7 NOT USED

2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be clear and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.9 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.10 VAPOR RETARDER

2.10.1 NOT USED

2.10.2 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to ASTM D 4397. A single ply of 0.25 mm polyethylene sheet; or, at the Contractor's option, a double ply of 0.15 mm polyethylene sheet shall be used. A fully compatible polyethylene tape which has equal or better water vapor control characteristics than the vapor retarder material shall be provided. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

2.10.3 Slip Sheet for Use With Vapor Retarder

Slip sheet for use with vapor retarder shall be a 0.24 kg per square meter rosin-sized, unsaturated building paper.

2.11 BEARING PLATES

Minimum 0.085 mm (22 ga) galvanized steel, 150 x 150 mm (6 x 6 in).

2.12 EPDM RUBBER BOOTS

Flashing devices around pipe penetrations shall be flexible, one-piece devices molded from weather-resistant EPDM rubber. Rubber boot material shall be as recommended by the manufacturer. The boots shall have base rings made of aluminum or corrosion resisting steel that conforms to the contours of the roof panel to form a weather-tight seal.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Roofing

Roof panels shall be installed with the standing seams in the direction of the roof slope. The standing seams shall be sealed around the concealed clip using a mechanical seaming machine. Side and end lap distances, joint sealing, and fastening and spacing of fasteners shall be in accordance with manufacturer's standard practice. Spacing of exposed fasteners shall present an orderly appearance and shall be permitted only at rakes, eaves, panel splices and where required for the attachment of flashings, gutter and similar accessories. Side laps and end laps of roof panels and joints at accessories shall be sealed. Fasteners shall be driven normal to the surface. Accessories shall be fastened into substrate, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction. The seaming machine shall be recalibrated on a daily basis to insure that end laps of panels are being sealed in conformance with the manufacturer's specifications.

3.1.2 Concealed Anchor Clips

Roof panels shall be fastened to the roof deck with concealed fastening clips. Clips shall be attached to the metal deck with bolts or screws. The maximum distance between clips and the spacing and type of clip shall conform with UL 580 Class I-90 performance requirements for the specific system to be installed on the project. In no case shall the distance between fasteners exceed 1500 mm on center.

3.1.3 Underlayment

Underlayment types shall be installed where shown on the drawings; they shall be installed directly over the substrate. If a roof panel rests directly on the underlayments, a slip sheet shall be installed as a top layer, beneath the metal roofing panels, to prevent adhesion. All underlayments shall be installed so that successive strips overlap the next lower strip in shingle fashion. Underlayments shall be installed in accordance with the manufacturer's written instructions. The underlayments shall ensure that any water that penetrates below the metal roofing panels will drain outside of the building envelope.

3.2 INSULATION INSTALLATION

Insulation shall be installed as indicated and in accordance with manufacturer's instructions. Insulation shall be continuous over entire roof surface. Where expansion joints, terminations, and other connections are made, the cavity shall be filled with batt insulation and vapor retarder providing equivalent R-Value and perm rating as remaining insulation.

3.2.1 Board Insulation

Rigid insulation shall be laid in close contact. If more than one layer of insulation is required, joints in the second layer shall be offset from joints in the first layer. Rigid insulation shall be attached to the metal roof deck with bearing plates and fasteners, as recommended by the insulation manufacturer, so that the insulation joints are held tight against each other, with no less than 1 fastener and bearing plate per 0.37 square meter of insulation. Layout and joint pattern of insulation and

fasteners shall be indicated on the shop drawings.

3.3 PROTECTION OF VAPOR RETARDER FROM ROOF DECK

A cloth industrial duct tape shall be adhered over all the seams of metal roof decking, at any penetration edges, and at all surface areas exhibiting sharp burrs or similar protrusions. For other types of roof decking, cloth industrial duct tape shall be adhered over all irregularities which could potentially puncture polyethylene membrane.

3.4 VAPOR RETARDER INSTALLATION

3.4.1 NOT USED

3.4.2 Polyethylene Vapor Retarder

The polyethylene vapor retarder membrane shall be installed over the entire surface. A fully compatible polyethylene tape shall be used to seal the edges of the sheets to provide a vapor tight membrane. Sheet edges shall be lapped not less than 150 mm. Sufficient material shall be provided to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with polyethylene tape.

3.5 SLIP SHEET INSTALLATION

Provide a slip sheet over the top of the underlayment as indicated on the drawings.

3.6 CONTRACTORS FIVE YEAR WARRANTY

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOF SYSTEM

FACILITY DESCRIPTION_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOF SYSTEM
(continued)

THE STANDING SEAM METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE NON-STRUCTURAL METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH UL 580. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE STANDING SEAM METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE STANDING SEAM METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOFING SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE STANDING SEAM METAL ROOFING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE ROOFING SYSTEM DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.

6. THIS WARRANTY APPLIES TO THE STANDING SEAM METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

**

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
STANDING SEAM METAL ROOF SYSTEM
(continued)

**REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS ROOF SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE STANDING SEAM METAL ROOF SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

MANUFACTURER'S TECHNICAL REPRESENTATIVE

I_____, A TECHNICAL REPRESENTATIVE EMPLOYED FOR A MINIMUM OF FIVE YEARS BY _____, THE ROOFING MANUFACTURER FOR THIS PROEJCT, HEREBY ATEST THAT THE ROOF INSTALLED FOR THIS PEOCJT BY_____ WAS CONSTRUCTED AND ASSEMBLED IN ACCORDANCE WITH THE MANUFACTURER'S APPROVED METHODS AND DETAILS AND MEETS THE MANUFACTURER'S PREMIUM 20 YEAR WEATHERTIGHTNESS WARRANTY REQUIREMENTS.

INSTALLER'S STATEMENT ON ROOF WARRANTY

I_____, THE ROOF INSTALLER FOR THIS PROJECT, HEREBY CERTIFY THAT THE PLANS AND SPECIFICATIONS HAVE BEEN THOROUGHLY REVIEWED AND THAT THE PROPOSED ROOF WILL MEET THE DESIGN INTENT AND MANUFACTURER'S REQUIREMENTS FOR A PREMIUM WEATHERTIGHTNESS PREMIUM 20 YEAR WEATHERTIGHTNESS WARRANTY REQUIREMENTS.

-- End of Section --

SECTION 07551R

SBS-MODIFIED BITUMEN SHEET ROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825c	(1998) Approval Guide Building Materials

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1998) Building Materials Directory
UL 790	(1997) Tests for Fire Resistance of Roof Covering Materials

1.2 SYSTEM DESCRIPTION

The modified bitumen roofing system shall consist of a manufacturer's standard, prefabricated, reinforced polymer-modified bitumen membrane, with base sheet, and insulation as specified and indicated. The manufacturer shall have a minimum of 5 years experience in manufacturing of the proposed modified bitumen sheet roofing for similar applications.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Acceptable Manufacturer Products; G, RE

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

Johns Manville Roofing System Group
717 17th Street
Denver, CO. 80202
800-654-3103

Siplast
Suite 1600N
222 West Los Colinas Blvd.
Irving, Texas 75039
972-869-0070

Modified Bitumen Roof Manuf. Product submitted as an "or equal"; G, RE.

SD-07 Certificates

Qualifications; G, RE

Evidence that the manufacturer has a minimum of 5 years experience manufacturing modified bitumen roofing. The roofing system applicator shall be approved by the modified bitumen roofing manufacturer, and shall have a minimum of 5 years experience as an approved applicator. A list of installations using the same products and applicator as proposed shall be included.

Materials; G, RE

Certificates of compliance for felts, bitumens, and membrane sheet.

SD-08 Manufacturer's Instructions

Materials and Installation; G, RE

Manufacturer's instructions, including membrane description and performance data, detailed procedure for installation, and safety precautions, prior to the start of roofing work.

SD-09 Samples

Samples of the following: 300 mm x 300 mm square samples of each color modified, bituminous, mineral-surface cap sheets to be exposed as finished roof surfaces.

SD-13 Records

Bills of Lading; G, RE

Bills of lading shall indicate the flash point and equiviscous temperature (EVT) and this information shall be shown on labels for each unit (or plug) of asphalt.

1.4 STORAGE OF MATERIALS

Felts and roofing sheets shall be kept dry before, during, and after

delivery to the site. Felts and roofing sheets shall be stored on end one level high, in an enclosed building or trailer and on platforms, off the deck or floor. Felts and sheets shall be maintained at a temperature above 10 degrees C for 24 hours immediately before laying.

1.5 COORDINATION REQUIREMENTS

The work shall be coordinated with other trades to ensure that components are available when they are to be secured or stripped into the roofing system.

1.5.1 Insulation Application

Application of roofing shall immediately follow application of insulation as a continuous operation.

1.5.2 Flashing

Modified bituminous sheet shall be used for flashings where the roof deck abuts angles, vertical surfaces, edge metal, and penetrations, unless otherwise specified or indicated. Flashing shall be installed as the work progresses.

1.5.3 Sheet Metalwork

Sheet metalwork specified in Section 07600 SHEET METALWORK, GENERAL shall be coordinated with roofing operations.

1.6 ENVIRONMENTAL CONDITIONS

Air temperature shall be above 4 degrees C and there shall be no visible ice, frost, or moisture on the roof deck at the time roofing is installed.

1.7 FLAME HEATED EQUIPMENT

Torch application shall be approved by the membrane manufacturer for the specific modified bitumen. Open flame equipment shall not be left unattended while ignited.

1.8 NOT USED

1.9 FIRE AND WIND UPLIFT REQUIREMENTS

The complete roof system shall have a UL 790, Class A or B classification, be listed as "fire classified" in UL Bld Mat Dir, and bear the UL label or be listed as a Class I Roof Deck in FM P7825c. Roofing system over steel deck shall be rated Class I-90 in accordance with FM P7825c. Ratings from other independent laboratories may be substituted provided that the tests, requirements and ratings are documented to be equivalent, to the satisfaction of the Contracting Officer.

1.10 WARRANTY

1.10.1 Special Project Warranty

Provide written warranty, signed by manufacturer of primary roofing materials and his authorized installer, agreeing to replace/repair defective materials and workmanship as required to maintain roofing system in watertight condition.

1.10.1.1 Roofing Guarantee

The roof and associated work, including all associated flashing, shall have a manufacturer's unlimited (no dollar limit) guarantee for the roofing system against leaks from faulty or defective materials and/or workmanship including leaks, slippage or other obvious deficiencies for a minimum period of twenty (20) years, starting on the date of the Owner's acceptance of the proejct. A manufacturer's guarantee will be issued at the completion of the project and will be attached to the Contractor's final payment request. The roofing installer shall provide an unlimited (no dollar) guarantee for the installation of the roof system against leaks due to faulty or defective materials and/or workmanship for 5 years. Installer/Product Supplier is to provide in their warranty documentation that a 48-hour response time to a leak will be met.

1.11 QUALITY ASSURANCE

1.11.1 Manufacturers Qualifications

Obtain primary products, including each type of roofing sheet, bitumen, membrane flashings, and vapor retarder (if any), from a single manufacturer. Provide secondary products as recommended by manufacturer of primary products for use with roofing system specified.

1.11.2 Installer Qualifications

Engage an experienced Installer (Roofer) who is certified by modified bituminous sheet roofing system manufacturer as qualified to install manufacturer's roofing materials.

1.11.2.1 Installer's Field Supervision

Require Installer to maintain a full-time supervisor/foreman on job site during times that modified bituminous sheet roofing work is in progress and who is experienced in installation of roofing systems similar to type and scope required for this Project.

1.11.3 Insurance Certification

Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.11.4 Preliminary Roofing Conference

As soon as possible after award of modified bitumen sheet roofing work, meet with Installer (Roofer), installers of substrate construction (roof decks) and other work adjoining roof system including penetrating work and

roof accessories, Architect, Owner, and representatives of other entities directly concerned with performance of roofing system including (as applicable) Owner's insurers and test agencies.

a. Review Requirements (Contract Documents), submittals, status of coordinating work, availability of materials, and installation facilities and establish preliminary installation schedule. Review requirements for inspections, testing, certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation procedures.

b. Discuss roofing system protection requirements for construction period extending beyond roofing installation. Discuss possible need for temporary roofing.

c. Record discussion, including agreement or disagreement on matters of significance, furnish copy of recorded discussions to each participant. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.11.5 Preapplication Roofing Conference

Approximately 2 weeks before scheduled commencement of modified bitumen sheet roofing installation and associated work, meet at Project site with Installer, installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Architect, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner's insurers, test agencies, and governing authorities.

1.11.5.1 Review Foreseeable Methods and Procedures

Review foreseeable methods and procedures related to roofing work, including but not necessarily limited to the following:

a. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations, and other preparatory work performed by other trades.

b. Review structural loading limitations of steel deck and inspect deck for loss of flatness and for required mechanical fastening.

c. Review roofing system requirements (drawings, specifications, and other contract documents).

d. Review required submittals, both completed and yet to be completed.

e. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

f. Review required inspection, testing, certifying, and material usage accounting procedures.

g. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).

1.11.5.2 Record

Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

PART 2 PRODUCTS

2.1 TEMPORARY ROOFING

2.1.1 Temporary Roofing Membrane

Two plies of asphalt-impregnated glass-fiber felt complying with ASTM D 2178, Type IV, set in and glaze-coated with hot moppings of ASTM D 312, Type III asphalt.

a. Provide base of rigid perlite board roof insulation over metal deck surfaces of minimum thickness as required to span between top flutes of deck without deflections, but not less than 19 mm. Attach to deck with FM-approved adhesive. (Note: Temporary roofing may serve as vapor retarder with upgrade of perlite board as detailed below).

2.2 VAPOR RETARDER

2.2.1 Bituminous Vapor Retarder

Two plies of asphalt-impregnated glass-fiber felt, complying with ASTM D 2178, Type IV, set in and glaze-coated with ASTM D 312, Type III asphalt.

a. Provide rigid perlite board roof insulation substrate over metal deck surfaces, thickness as required to span flutes without deflection, 25 mm minimum thickness. Mechanically fasten to deck.

2.3 ROOF INSULATION

2.3.1 Perlite Board Insulation

Rigid, noncombustible, perlite-fiber boards of thicknesses indicated, with k-value of 0.36 at 75 deg F (24 deg C), integrally skinned surfaces, complying with ASTM C 728. Provide manufacturer's standard sizes (for use detailed above).

2.3.2 Polyisocyanurate-Foam Board Insulation

Rigid boards of minimum 2.0-pcf density polyisocyanurate-based foam core, bonded to roofing felt facer sheets. Provide in thickness indicated, with a minimum k-value of 0.17 when tested according to ASTM C 518 after insulation is conditioned per RIC/TIMA 281-1 Conditioning Procedure. Provide in manufacturer's standard sizes.

2.3.2.1 Composite Type

In lieu of bottom felt cover, provide 19 mm thick, integrally bonded course of rigid, perlite-or mineral-fiber insulation board to form composite board with polyisocyanurate insulation.

2.3.3 Fiberboard Insulation

Rigid boards of wood fiber or other organic fiber and water-resistant binders, asphalt impregnation not exceeding 4 percent, chemically treated for deterioration, with k-value of 0.36 at 75 deg F (24 deg C); comply with ASTM C 208, Roof Insulating Board. Provide manufacturer's standard sizes (for uses detailed below).

2.3.4 Insulation Overlay Board

High-density wood fiberboard, minimum density 15 pcf, 13 mm thick; ASTM C 208 Roof Insulation Board.

2.4 MODIFIED BITUMINOUS SHEET ROOFING SYSTEM

2.4.1 Modified Bituminous Sheet, General

Furnish modified bituminous sheet materials complying with the following:

a. Breaking Strength: ASTM D 412, minimum 175 lb.

b. Ultimate Elongation (elongation at break): ASTM D 412, 8.0 percent.

c. Water Resistance: ASTM D 570, will not absorb more than 1.0 gram of water and dimensional change will not exceed 1.0 percent (ASTM D 1204).

d. Water Vapor Transmission: ASTM E 96, maximum 1.0 gram in 24 hours.

e. Dynamic Impact (puncturing): Pass water-tightness test after impact of 3.6 ft. lb.

f. Lap Joint Strength: ASTM D 412, 176 lbf., after immersion at 50 deg F for 5 days plus five freeze-thaw cycles.

g. Base Sheet: Asphalt-impregnated and -coated, glass-fiber base sheet dusted with mineral granules both sides, complying with ASTM D 4601, Type II.

h. Interply Sheets: Two plies of a uniformly porous sheet with heavy-duty fiber glass mat, impregnated with asphalt, dusted lightly with mineral granules on top side, complying with ASTM D 2178-89, Type VI.

i. Interply Bitumen: Roofing asphalt, complying with ASTM D 312, Type III.

j. Modified Bitumen Sheet Membrane / Mineral Surfaced (Granular Cap Sheet): Styrene Butadiene Styrene (SBS)-modified asphalt sheets with continuous layer of mineral granules factory-applied to top exposed surface; manufacturer's standard sheet thickness. Granule color: Selected by Architect from manufacturer's full range of standard colors.

a. Sheet Reinforcing: Woven or non-woven polyester.

k. Comply with "NRCA Roofing and Waterproofing Manual," Specification Plate No. 47-3--IMBF.

l. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

a. Manville Sales Corporation.
b. Siplast, Inc.
c. Soprema Roofing and Waterproofing, Inc.

2.5 MISCELLANEOUS MATERIALS

2.5.1 Wood Members

Comply with requirements of Division 6 Section "Miscellaneous Carpentry" for wood members indicated as roofing system work.

2.5.2 Cants

Perlite board, ASTM C 728 or wood fiberboard, ASTM C 208. (Manufacturer's Option).

2.5.3 Tapered Edge Strips

Rigid perlite board, ASTM C 728 or rigid wood fiberboard, ASTM C 208 per manufacturer's standard detailing.

2.5.4 Walkway Protection Boards

Mineral-surfaced bituminous composition boards, approximately 13 mm thick, manufactured specifically for hot bituminous application or modified bitumen sheet roofing as a protection course for foot traffic.

2.5.5 Available Products

Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Carey-Tread, Celotex Corporation.
b. J-Walk, Manville Sales Corporation.
c. White Walk, W. R. Meadows, Inc.

2.5.6 Substrate Joint Tape

150 mm or 8-inch-wide, coated, glass-fiber joint tape.

2.5.7 Mastic Sealant

Polyisobutylene (plain or bituminous modified), nonhardening, nonmigrating, nonskinning, and nondrying.

2.5.8 Fasteners

Galvanized steel, fluoropolymer-coated steel, or nonferrous metal screws. Size, length, and type recommended by manufacturer as suitable for material to be fastened, substrate, and that will comply with requirements of governing authorities and listing agencies.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrate surfaces to receive modified bitumen sheet roofing system and associated work and conditions under which roofing will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

a. Verify that flatness and fastening of metal roof decks comply with installation tolerances specified in Division 5 Section "Steel Deck".

3.2 GENERAL INSTALLATION REQUIREMENTS

3.2.1 Inspection and Test Agencies

Cooperate with inspection and test agencies engaged or required to perform services in connection with installing modified bitumen sheet roofing system.

3.2.2 Protect

Protect other work from spillage of modified bitumen roofing materials, and prevent liquid materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of modified bituminous sheet roofing system work.

3.2.3 Insurance/Code Compliance

Where required, install and test modified bitumen sheet roofing system to comply with governing regulations and specified insurance requirements.

3.2.4 Coordinate

Coordinate installing roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight. Provide cut offs at end of each day's work to cover exposed ply sheets and insulation with a course of coated felt with joints and edges sealed with roofing cement. Remove cut offs immediately before resuming work.

3.2.5 Asphalt Bitumen Heating

Heat and apply bitumen according to EVT Method as recommended by NRCA. Do not raise temperature above minimum normal fluid-holding temperature necessary to attain EVT (plus 5 deg F) more than 1 hour prior to time of application. Determine flash point, finished blowing temperature, EVT, and fire-safe handling temperature of bitumen either by information from manufacturer or by suitable tests. Do not exceed recommended temperature limits during bitumen heating. Do not heat bitumen to a temperature higher than 25 deg F below flash point. Discard bitumen that has been held at temperature exceeding finish blowing temperature (FBT) for more than 3 hours. Keep kettle lid closed except when adding bitumen.

3.2.6 Bitumen Mopping Weights

For interply mopping, apply bitumen at the rate of 25 lb of asphalt per roof square (plus or minus 25 percent on a total-job average basis).

3.2.7 Substrate Joint Penetrations

Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction. Where mopping is applied directly to substrate, tape substrate joints or, where steep asphalt is used, hold asphalt back 50 mm from both sides of the joint.

3.2.8 Cutoffs

At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and any insulation. Provide temporary covering of two plies of No. 15 roofing felt set in full moppings of hot bitumen; remove at beginning of next day's work.

3.2.9 Temporary Roofing on Steel Decks

Apply continuous ribbons of Type III hot asphalt to deck at 150 mm o.c.; thickness sufficient to spread to 50 mm in width when insulation is placed. Install one course of perlite board roof insulation in hot asphalt; thickness as required to span deck flutes but not less than ½-inch thick. Apply two plies of roofing felts, lapping each felt 19 inches over preceding one, using solid moppings of Type III asphalt at a rate of 20 lb per square (plus or minus 25 percent). Glaze-coat completed surface with Type III asphalt at rate of 20 lb per square (plus or minus 25 percent).

a. Comply with NRCA "Low-Slope Roofing Manual" Specification 10-TR and Diagram TR-SI.

3.2.10 Temporary Roof

Remove temporary roof completely prior to installing permanent roofing system. (Note: Temporary roofing installed to standards of vapor retarder as detailed may be retained).

3.3 VAPOR RETARDER INSTALLATION

3.3.1 Vapor Retarder on Steel Decks

Mechanically fasten one course of perlite board roof insulation in thickness as required to span deck flutes, but not less than 25 mm thick. Use FM-approved fasteners specifically designed for securing insulation boards to steel roof deck and driven through metal discs. Space fasteners in accordance with FM requirements for specified Windstorm Resistance Classification. Locate end joints of insulation over deck flutes.

3.3.2 Insulation Board

Over insulation board, apply two plies of vapor retarder felts, lapping each felt 483 mm over the preceding one. Fully adhere each ply to deck using Type III asphalt at the rate of 20 lb per square (plus or minus 25 percent). Glaze-coat completed surface with Type III asphalt at rate of 20 lb per square (plus or minus 25 percent).

a. Comply with "NRCA Low-Slope Roofing Manual" Specification 11-VR and Diagram VR-SI.

b. Apply tow-course stripping of glass-fiber fabric and roofing cement at obstructions and penetrations through vapor retarder.

3.4 INSTALLING INSULATION

3.4.1 General

Comply with insulation manufacturer's instructions and recommendations for the handling, installation, and bonding or anchorage of insulation to substrate.

3.4.2 Hot Solid Mopping

Set insulation in hot solid mopping of Type III asphalt, applied within temperature range of EVT plus or minus 25 deg F (14 deg C) and at rate of 25 lb per 100 sq. ft. (plus or minus 15 percent on total-job basis). Run long joints of insulation in continuous straight line, perpendicular to roof slope, with end joints staggered between rows.

3.4.3 Two-Layer Installation

Where overall insulation thickness is 50 mm or greater, install required

thickness in two layers with joints of second layer staggered from joints of first layer a minimum of 300 mm each direction. Install second layer in full mopping of hot Type III asphalt.

3.4.4 Trim Surface

Trim surface of insulation where necessary at roof drains so completed surface is flush with ring of drain.

3.4.5 Nailers

Where insulated substrates slope more than ½ inch per foot, install wood nailers of same thickness as insulation, spaced not more than 609 mm to 6400 mm apart and between insulation boards, depending on board size. Anchor nailers to substrate. Run nailers perpendicular to slope of roof unless otherwise indicated.

3.5 ROOF MEMBRANE INSTALLATION

3.5.1 Shingling Plies

Install membrane with ply sheets shingled uniformly to achieve required number of membrane plies throughout. Shingle in proper direction to shed water on each large area of roofing, where slope is significant (over 50 mm per foot).

3.5.2 Cant Strips / Tapered Edge Strips

Install preformed 45-degree cant strips at junctures of modified bituminous sheet roofing system membrane with vertical surface. Provide preformed, tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

3.5.3 Base Sheet

Install one lapped course of base sheet. Mop to non-nailable substrate with steep asphalt, except use special adhesive where indicated.

3.5.4 Interply Sheets

Install the number and type(s) of ply sheets, lapped amount indicated to form a continuous, uniform membrane with continuous bitumen moppings between sheets so that ply sheets do not touch.

3.5.5 Set-On Accessories

Where small roof accessories are set on modified bituminous sheet roofing, set metal flanges in a bed of roofing cement and seal penetration of membrane with bead of roofing cement to prevent flow of bitumen from membrane.

3.5.6 Lap Joints

All lap joints shall have positive "runout" at joint edge. Runout shall

have granules of the roof color applied while bitumen is hot upon final installation of cap sheet.

3.6 MEMBRANE FLASHING AND STRIPPING

3.6.1 Modified Bituminous Flashing

Install modified bituminous flashing at cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof. Install one ply of flashing sheet material by mopping substrate and back of flashing sheet with Type III asphalt and embedding flashing solidly against substrate. Extend flashing a minimum of 150 mm onto modified bituminous sheet roofing.

3.6.2 Modified Bituminous

Install modified bituminous stripping where metal flanges are set on roofing. Install one ply of modified bituminous stripping in a continuous mopping of Type III asphalt and extend stripping a minimum of 150 mm out onto the roof membrane.

3.6.3 Rood Drains

Set 762 x 762 mm lead flashing sheet in bed of roofing cement on completed modified bituminous roofing sheet. Cover lead sheet with modified bituminous stripping, with stripping extending a minimum of 100 mm beyond edge of lead flashing onto roof membrane. Clamp roof membrane, lead flashing, and stripping into roof drain clamping ring.

3.6.4 Expansion of Running Metal Flashing

Allow for expansion of running metal flashing and edge trim that adjoins roofing. Do not seal or bond membrane or modified bituminous flashing or stripping to metal flanges over 3 feet in length.

3.6.5 Counter-Flashings

Counter-Flashings, cap flashings, expansion joints, and similar work to be coordinated with modified bitumen roofing work are specified in other Sections.

3.6.6 Roof Accessories

Miscellaneous sheet metal accessory items, including piping vents, insulation vents and other devices to be coordinated with modified bituminous roofing system work, are specified in other Sections.

3.6.7 Cap Sheet Surfacing

Promptly after completing base sheet (same day where possible), apply one lapped course of cap sheet of type indicated. Set cap sheet in uniform mopping of same hot bitumen used in ply-sheet course, at average rate of 15 lb per square, with 6 mm bitumen flow exposed along cap sheet edge. Lap edges 100 mm and sheet ends 150 mm minimum.

3.7 ROOF WALKWAYS

3.7.1 Composition Board Walkways

Provide walkway protection boards at locations shown, using units of size shown, or if size not shown, using units of manufacturer's standard size, 13 mm thick. Set units in additional pour coat of hot bitumen after aggregate surfacing modified bituminous sheet membrane.

3.8 PROTECTING ROOFING

3.8.1 Protect Roofing During Remainder of Construction Period

Protect roofing during remainder of construction period. At end of construction period, or at a time when remaining construction will in no way affect or endanger roofing, inspect roofing and prepare a written report, with copies to Architect and Owner, describing nature and extent of deterioration or damage found.

3.8.2 Repair or Replace

Repair or replace (as required) deterioration or defective work found at time of above inspection to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

3.9 FIRE WATCH

Fire watch shall be provided continuously during and for at least 1 hour following torch application. At least two 9.46 liter containers of water and two 6.8 kg carbon dioxide extinguishers shall be available during the fire watch. When work is interrupted, or at the end of a section of roofing, and at end of each day's work, areas which had been subjected to torch applications shall be surveyed with an infra-red sensing device. Hot spots shall be cooled and re-surveyed. If a hot spot persists, the roof shall be cut open and any smoldering shall be extinguished before the foreman leaves the site.

3.10 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roofing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.

b. Verification of compliance of materials before, during, and after installation.

c. Inspection of condition of equipment and accuracy of thermometers

and metering devices.

d. Inspection of flashings, cants and curbs.

e. Inspection of membrane placement, including edge envelopes, widths of starter sheets, laps, proper use of squeegee, and mechanical fastening.

f. Inspection of application of bitumen, aggregate, and walkways.

g. Inspection of embedment of aggregate for required weight and coverage.

h. Cutout sampling and analysis as directed.

-- End of Section --

SECTION 07600A

SHEET METALWORK, GENERAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 32	(1996) Solder Metal
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2822	(1991; R 1997el) Asphalt Roof Cement
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos Containing
ASTM D 4586	(1993; R 1999) Asphalt Roof Cement, Asbestos Free
ASTM D 543	(1995) Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 822	(1996) Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Exposure Apparatus
ASTM D 828	(1997) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation-Apparatus
ASTM E 96	(2000) Water Vapor Transmission of

Materials

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual (1993; Errata; Addenda Oct 1997)
Architectural Sheet Metal Manual

1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Application of bituminous strip flashing over various sheet metal items is covered in Section 07551R SBS-MODIFIED BITUMEN SHEET ROOFING. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Division 15.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Materials; G, RE

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA Arch. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the

requirements specified below and to the thicknesses and configurations established in SMACNA Arch. Manual. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

2.1.2 Sheet Materials

ASTM A 653M, Factory coated, galvanized steel, G90, minimum thickness of 1.3 mm, factory coated with fluoropolymer coating. Color to match Standing Seam Metal Roof specified in Section 07412 or as indicated on the drawings.

2.1.2.1 Factory Color Finish

Panels shall have a factory applied polyvinylidene fluoride finish of 0.8 +/- 0.05 mil on both sides. The exterior finish shall consist of a 0.8 +/- 0.05 mil 70 percent Hylar 5000 or 70 percent Kynar 500 color and a 0.8 +/- 0.05 mil 70 percent Hylar 5000 or 70 percent Kynar 500 clear top coat. Color shall match the color indicated on the drawings and in Section 09915 COLOR SCHEDULE. The exterior color finish shall meet the test requirements as described in Section 07412.

2.1.3 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586. For coal tar roofing; coal tar cement conforming to ASTM D 4022.

2.1.4 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900 JOINT SEALING.

2.1.5 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application. Stainless steel fasteners (Type 304) and clips to be used for fascia and soffit panel installation.

2.1.6 Felt

ASTM D 226, Type I.

2.1.7 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 1.9 mm minimum thickness.

2.1.8 NOT USED

2.1.9 Copper

ASTM B 370, Temper H 00.

2.1.10 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

2.1.11 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.12 Through-Wall Flashing

a. Electro-sheet copper not less than 0.14 kg, factory coated both sides with acid- and alkali-resistant bituminous compound not less than 1.8 kg per square meter or factory covered both sides with asphalt-saturated cotton fabric, asphalt saturated glass-fiber fabric, or with 18 kg reinforced kraft paper bonded with asphalt.

b. Stainless steel, Type 304, not less than 0.25 mm thick, completely encased by and permanently bonded on both sides to 23 kg high strength bituminized crepe kraft paper, using hot asphalt, heat, and pressure.

c. Nonreinforced, waterproof, impermeable extruded elastomeric single ply sheeting not less than 0.76 mm thick.

d. 0.09 kg copper sheet, with 0.05 mm of dense, clear, polyethylene sheet bonded to each side of the copper.

e. Other through-wall flashing material may be used provided the following performance criteria are met.

(1) No cracking or flaking when bent 180 degrees over a 0.8 mm mandrel and rebent at the same point over the same mandrel in an opposite direction at 0 degree C .

(2) Water vapor permeability not more than 115 ng per Paper second per square meter (2 perms) when tested in accordance with ASTM E 96.

(3) Minimum breaking strength of 24 kgf/15 mm width in the weakest direction when tested in accordance with ASTM D 828.

(4) No visible deterioration after being subjected to a 400-hour direct weathering test in accordance with ASTM D 822.

(5) No shrinkage in length or width and less than 5 percent loss of breaking strength after a 10-day immersion, per ASTM D 543, in 5 percent (by weight) solutions, respectively, of sulfuric acid, hydrochloric acid, sodium hydroxide or saturated lime (calcium hydroxide).

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Gutters, downspouts, and collector heads shall be designed and fabricated in conformance with SMACNA Arch. Manual; louvers shall be fabricated in conformance with SMACNA Arch. Manual and as indicated. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 13 mm hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing.

3.2 EXPANSION JOINTS

Expansion joints shall be provided as specified in SMACNA Arch. Manual. Expansion joints in continuous sheet metal shall be provided at 12.0 meter intervals for copper and stainless steel and at 9.6 meter intervals for aluminum, except extruded aluminum gravel stops and fasciae which shall have expansion joints at not more than 3.6 meter spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

3.3.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section 09900 PAINTING, GENERAL.

3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

3.4 CONNECTIONS AND JOINTING

3.4.1 Soldering

Soldering shall apply to copper, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing

soda and rinsed with clean water.

3.4.2 Riveting

Joints in aluminum sheets 1.0 mm or less in thickness shall be mechanically made.

3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 25 mm wide. Unsoldered plain-lap seams shall lap not less than 75 mm unless otherwise specified. Flat seams shall be made in the direction of the flow.

3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 3 mm apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 300 mm on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

3.6 GUTTERS, DOWNSPOUTS, AND COLLECTOR HEADS

Gutters, downspouts, and collector heads shall be installed as indicated. Gutters shall be supported by cleats spaced not less than 915 mm apart. Downspouts shall be rigidly attached to the building. Supports for downspouts shall be spaced according to manufacturer's recommendations. Install collector heads per SMACNA Plate #26.

3.7 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

3.7.1 Base Flashing

Metal base flashing shall be coordinated with roofing work. Metal base flashing shall be set in plastic bituminous cement over the roofing membrane, nailed to nailing strip, and secured in place on the roof side with nails spaced not more than 75 mm on centers. Metal base flashing shall not be used on built-up roofing.

3.7.2 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as shown in SMACNA Arch. Manual. Where bituminous base flashings are provided, the counter flashing shall extend down as close as practicable to the top of the cant strip. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.7.3 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.7.4 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further into the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

3.7.4.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 50 mm, or shall be applied over top of masonry and precast concrete lintels. Bedjoints of lintels at control joints shall be underlaid with sheet metal bond breaker.

3.7.4.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 100 mm beyond ends of sill except at control joint where the flashing shall be terminated at the end of the sill.

3.7.5 Valley Flashing

Valley flashing shall be installed as specified in SMACNA Arch. Manual and as indicated.

3.8 FASCIA

Fascia shall be fabricated and installed as indicated and in accordance with SMACNA Arch. Manual.

3.9 INSTALLATION OF LOUVERS

Louvers shall be rigidly attached to the supporting construction. The installation shall be rain-tight. Louver screen shall be installed as indicated.

3.10 REGLETS

Reglets shall be a factory fabricated product of proven design, complete with fittings and special shapes as required. Open-type reglets shall be filled with fiberboard or other suitable separator to prevent crushing of the slot during installation. Reglet plugs shall be spaced not over 300 mm on centers and reglet grooves shall be filled with sealant. Friction or slot-type reglets shall have metal flashings inserted the full depth of slot and shall be lightly punched every 300 mm to crimp the reglet and counter flashing together. Polyvinyl chloride reglets shall be sealed with the manufacturer's recommended sealant.

3.11 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification of compliance of materials before, during, and after installation.

c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

-- End of Section --

SECTION 07810N

SPRAY-APPLIED FIREPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1998) Surface Burning Characteristics of Building Materials
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 605	(1993; R 1996) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E 759	(1992; R 1996) Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 760	(1992; R 1996) Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 761	(1992) Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 859	(1993) Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members
ASTM E 937	(1993) Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 1042	(1992; R 1997) Acoustically Absorptive Materials Applied by Trowel or Spray

ASTM G 21 (1996) Determining Resistance of Synthetic Polymeric Materials to Fungi

THE ASSOCIATION OF THE WALL AND CEILING INDUSTRIES INTERNATIONAL (AWCI)

AWCI 12A Testing and Inspection of Field Sprayed Fire-Resistive Materials; An Approved Guide

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir (1998) Fire Resistance Directory

1.2 DEFINITIONS

a. "Concealed areas" are those in which there is no regular human or mechanical contact. These areas include the above dropped ceilings; areas in warehouses not accessible by forklift, ladder, catwalk, etc.; and areas behind permanent construction.

b. "Exposed areas" are exposed to view upon completion of construction and/or subject to frequent human or mechanical contact. That includes, but is not limited to areas where any of the following are present: physical abuse, high humidity, air erosion, or a corrosive atmosphere. Examples of this type of area would include stairwells and mechanical rooms.

c. "Heavy abuse and deluge areas" include: interior exposed with heavy abuse, exterior exposed with heavy abuse or exposure to the weather, and areas protected by a deluge-type automatic sprinkler system. Some examples include parking garages and some warehouses.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-06 Test Reports

Spray-applied fireproofing; G, RE

Submit test reports and test records from a certified independent laboratory, attesting that the fireproofing material and installation procedures conform to the requirements of the paragraphs entitled "Spray-Applied Fireproofing" and "Field Quality Control." Submit test reports to the Contracting Officer. Performance test reports shall conform to the requirements of the applicable test method.

Visual tests; G, RE

Submit test reports for visual tests of concealed areas to the Contracting Officer.

SD-08 Manufacturer's Instructions

Manufacturer's inspection; G, RE

Installer qualifications; G, RE

1.4 MANUFACTURER'S INSPECTION

The general contractor is responsible for obtaining and submitting the manufacturer's certification of approval for the type(s) and area(s) where sprayed fire protection material is to be applied.

1.5 INSTALLER QUALIFICATIONS

Engage an experienced installer that is certified, licensed, or otherwise qualified by the spray-on fireproofing manufacturer as having the necessary experience, staff, and training to install the manufacturer's products in accordance with specified requirements. The installer engaged by the Contractor shall demonstrate 3 years of experience and a minimum of three installations with the type(s) of sprayed fire protection material specified for this project. A manufacturer's willingness to sell its products to the Contractor or installer does not infer qualification of the buyer.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver packaged materials to the job site in the original sealed packages and containers, properly marked and labeled to show manufacturer's name, brand, and certification of compliance with the requirements of the paragraphs entitled "Fire Hazard Classification" and "Fire Resistive Rating" of this section. Keep fireproofing materials dry until ready to be used and stored off the ground, under cover, and away from damp surfaces. Damaged or opened containers shall be rejected. Apply materials with shelf-life prior to expiration of the shelf-life period.

1.7 ENVIRONMENTAL CONDITIONS

1.7.1 Temperature

Maintain substrate and ambient air temperature above 4 degrees C during application, and for 24 hours before and 24 hours after application. Maintain relative humidity within the limits recommended by the fireproofing manufacturer.

1.7.2 Ventilation

Provide adequate ventilation by natural or forced-air means at a minimum total air exchange of four times per hour during and after application until fireproofing is adequately dried.

1.8 PRE-CONSTRUCTION CONFERENCE

The Contractor shall hold a meeting for the spray-on fireproofing installer, the Contracting Officer and subcontractors (whose employees come

into contact with the fireproofing) prior to the installation of any spray-on fireproofing material to discuss installation methods, patching, repair, and other issues.

1.9 PRE-INSTALLATION CONFERENCE

Hold a meeting with the Contractor, spray-on fireproofing installer, field testing agency, and manufacturer immediately prior to the application of the fireproofing. Review the substrates for acceptability, method of application, applied thickness, inspection and testing procedures, and other issues.

PART 2 PRODUCTS

2.1 SPRAY-APPLIED FIREPROOFING

2.1.1 Materials

Materials shall comply with ASTM E 1042. Materials to be used: Type I cementitious fireproofing or Type II sprayed-fiber fireproofing. Only Type I fireproofing is allowed in waterfront areas where the fireproofing may be directly exposed to a natural body of water.

2.1.2 Physical Properties

Measure physical properties according to minimum values, unless otherwise indicated or unless higher values are required to attain a specified fire resistance rating. Measure these physical properties according to the test methods referenced with each property.

2.1.2.1 Deflection

Material shall not crack, spall, or delaminate when backing to which it is applied is subject to downward deflection 1/120 of clear span of 3 m when tested in accordance with ASTM E 759.

2.1.2.2 Bond Impact

Material shall not crack, spall, or delaminate when tested in accordance with ASTM E 760.

2.1.2.3 Air Erosion

Dust removal shall not exceed 0.25 gram per square meter when tested in accordance with ASTM E 859.

2.1.2.4 Corrosion of Steel

Material shall not contribute to corrosion when tested in accordance with ASTM E 937.

2.1.2.5 Fire Hazard Classification

Material shall have a flame spread of 25 or less and a smoke developed

rating of 50 or less when tested in accordance with ASTM E 84.

2.1.2.6 Fire Resistance Rating

The fire resistance rating for building elements shall be as indicated and shall conform to the fire rated assemblies as listed in UL Fire Resist Dir. Performance tests shall be in accordance with ASTM E 119.

Fire Rating Schedule

Element	Hourly Rating	UL Design Reference
Roof decks	1 Hour	P732
Roof supports	1 Hour	P732

2.1.2.7 Resistance to Mold Growth

Resistance is to be 28 days for general application and 60 days for materials installed in air-handling plenums and shall be measured in accordance with ASTM G 21.

2.1.2.8 Bond Strength, Compressive Strength, and Dry Density

	Concealed Areas	Exposed Areas	Heavy Abuse/Deluge	Test No.
Bond Strength	Minimum individual bond strength of 150 lbf/ft2 minimum average bond strength of 200 lbf/ft2	Minimum bond strength of 434 lbf/ft2	Minimum bond strength of 7000 lbf/ft2	ASTM E 736
Compressive Strength	Minimum compressive strength of 5.21 lbf/in.2	Minimum compressive strength of 52 lbf/in.2	Minimum compressive strength of 350 lbf/in.2	ASTM E 761
Dry Density	Minimum of 15 pcf	Minimum of 22 pcf	Minimum of 40 pcf	ASTM E 605 or AWCI 12A, Appendix A

2.2 BONDING ADHESIVE

Use adhesive where required to achieve a fire resistance rating or where recommended by the fireproofing material manufacturer.

2.3 SEALER

Use sealer where recommended by the fireproofing material manufacturer. The sealer shall be tinted to differentiate between it and the fireproofing on which it is applied. Sealer shall be fungus resistant and fire hazard

classified under the paragraph entitled "Fire Hazard Classification."

2.4 WATER

Water shall be clean, fresh, potable, and free from amounts of oils, acids, alkalis, and organic matter that would be injurious to the fireproofing.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces to be fireproofed by removing dirt, grease, oil, loose paint, rust and mill scale, or other contaminants that will interfere with the proper bonding. Clear ceiling areas to be fireproofed of obstructions interfering with the application of the spray-applied fireproofing. Install support sleeves, inserts, clips, hanger attachment devices, and the like prior to the application of the fireproofing.

3.2 SURFACE ACCEPTABILITY

Surfaces that are painted or primed that are to receive spray-on fireproofing must be bond tested according to the requirements in UL Fire Resist Dir, "Fire Resistance Ratings - Coating Materials." Test painted steel surfaces in accordance with ASTM E 736 with the spray-applied fireproofing material. The Contractor shall certify the acceptability of surfaces to receive sprayed fireproofing. Surfaces to receive sprayed fireproofing are to be clean and in acceptable condition for application of spray-applied fireproofing.

3.3 MIXING

Mix fireproofing materials in accordance with the manufacturer's recommendations. When required mechanically control the material to water ratio. For jobs not requiring mechanical mixing, refer to manufacturer's specification for mixing.

3.4 EXTENT OF FIREPROOFING

The underside of electrified decks shall be protected with spray-applied fireproofing, unless otherwise specified. The following areas do not receive sprayed fireproofing:

a. Structural steel and underside of steel decks in elevator machine rooms.

b. Steel bearing members in elevator hoistways.

3.5 APPLICATION

a. Apply fireproofing material prior to the installation of ductwork, piping, and conduits. Prior to spray application, cover surfaces not to receive spray-applied fireproofing, including instruments, gages, equipment, and floor surfaces to prevent contamination by splatter, rebound, and overspray. Cover exterior openings in

areas to receive spray-applied fireproofing prior to and during application of fireproofing with tarpaulins or other approved material.

b. Apply bonding adhesive and sealer for Type II materials, when not an integral part of the fireproofing material, in strict accordance with the manufacturer's recommendations. Apply adhesive to the substrate prior to applying fireproofing material. Apply fireproofing material to a thickness as required to obtain the specified fire resistance rating and to provide a fire-protective coating of uniform density and texture. Apply fireproofing in accordance with the procedure recommended by the manufacturer. Apply sealer to clean, dry fireproofed surfaces in accordance with manufacturer's recommendations.

c. Apply fireproofing to underside of steel roof deck or steel floor assemblies after respective roof or floor construction is complete. Allow no roof or floor traffic during application and during a 7-day minimum curing period.

d. The minimum average thickness shall be no less than 9.525 mm . Thicknesses cannot be less than that required to achieve designated fire resistance ratings. If the specified thickness is greater than or equal to 25.4 mm, any individual measurement cannot be less than the specified thickness minus 6.35 mm. If the specified thickness is less than 25.4 mm, any individual measurement cannot be less than the specified thickness minus 25 percent.

3.6 FIELD QUALITY CONTROL

3.6.1 Field Tests

3.6.1.1 Testing Agency

An independent laboratory is to be selected by the architect and paid for by the Contractor.

3.6.1.2 Extent and Testing Methodology

Testing of complete fireproofing will take place in successive stages in areas of extent described below. Do not proceed with fireproofing to the next area until the present area has been tested and passes the requirements of this section.

3.6.1.3 Size of Test Area

A test sample shall be located every 920 square meters of floor area or each floor, whichever produces the greatest number of test areas.

3.6.1.4 Extent of Test

Unless stated otherwise, within each test area the testing agency will select one structural member of each type (primary beam, secondary beam,

joist, truss, steel deck or concrete slab, and column) and test the fireproofing.

3.6.1.5 Tests To Be Conducted

a. Thickness: The independent laboratory shall sample and verify the thickness of the fireproofing in accordance with provisions of ASTM E 605.

b. Bond Strength: Determine bond strength in accordance with ASTM E 736.

c. Density: Determine densities in accordance with ASTM E 605 or Appendix A, "Alternate Method for Density Determination" of AWCI 12A. Take density determinations at the flat portion of deck, beam bottom flange, beam web, column, and an equivalent area from the top of the lower beam flange. Areas showing a density less than specified will be rejected.

d. Compressive Strength: Determine compressive strength in accordance with ASTM E 761.

3.6.2 Visual Inspections

Inspections shall be made by the certified independent laboratory prior to closure of concealed areas. These inspections may be phased, but shall not occur less than 5 working days prior to the enclosure of the fireproofing.

Conduct final inspection of sprayed areas. Inspect fireproofed surfaces after mechanical, electrical, and other work in contact with fireproofing material has been completed and before sprayed material is covered.

3.6.3 Repair and Retesting

Re-spray all test areas and any rejected areas with fireproofing material.

Rejected areas shall be retested. Re-spray areas requiring additional fireproofing material as a result of the visual inspections to provide proper thickness for the specified fire resistance rating.

3.7 CLEANUP

Clean surfaces not indicated to receive fireproofing thoroughly of sprayed material within a 24 hour period after application.

3.8 PATCHING

Patching and repairing of damaged fireproofing is the responsibility of the Contractor. The patching material shall be the same as that specified for that area.

-- End of Section --

SECTION 07840A

FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 814	(1997) Fire Tests of Through-Penetration Fire Stops
ASTM E 1399	(1997) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Dec 1998) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994; Rev thru Feb 1998) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials; G, RE.

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resist Dir or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations or construction joints are to receive firestopping, drawings shall indicate location and type of application.

SD-07 Certificates

Firestopping Materials; G, RE.

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications.

Documentation of training and experience.

Inspection; G, RE.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free products complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 100 mm or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

-- End of Section --

SECTION 07900A

JOINT SEALING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 570	(1995) Oil- and Resin-Base Caulking Compound for Building Construction
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Backing; G, RE.

Bond-Breaker; G, RE.

Sealant; G, RE.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

SD-07 Certificates

Sealant.

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 4 to 32 degrees C when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 4 and 32 degrees C unless otherwise specified by the manufacturer.

PART 2 PRODUCTS

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 2, closed cell, Class A, round cross section.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 Neoprene

Neoprene backing shall be ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 CAULKING

Oil- and resin-based caulking shall be ASTM C 570, Type A, Use interior low

movement.

2.5 SEALANT

2.5.1 LATEX

Latex Sealant shall be ASTM C 834.

2.5.2 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

a. Silicone sealant: Type S, Grade NS, Class 25, Use NT, M G A.

2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be

as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

-- End of Section --

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.4	(1994) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings
ANSI A250.6	(1997) Hardware on Standard Steel Doors (Reinforcement - Application)
ANSI A250.8	(1998) SDI-100 Recommended Specifications for Standard Steel Doors and Frames

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM D 2863	(1997) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115	(1991) Steel Door Preparation Standards (Consisting of A115.1 through A115.6 and A115.12 through A115.18)

HOLLOW METAL MANUFACTURERS ASSOCIATION (HMMA)

HMMA HMM (1992) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

NFPA 252 (1999) Standard Methods of Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDOI)

SDI 105 (1998) Recommended Erection Instructions for Steel Frames

SDI 113 (1979) Apparent Thermal Performance of STEEL DOOR and FRAME ASSEMBLIES

UNDERWRITERS LABORATORIES (UL)

UL 10B (1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors; G, RE

Frames; G, RE

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Submit door and frame locations.

SD-03 Product Data

Doors; G, RE

Frames; G, RE

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction,

panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to ANSI A250.8 requirements.

SD-09 Reports

Fire Rated Doors; G, RE

A letter by a nationally recognized testing laboratory which identifies the product manufacturer, type, and model; certifying that the laboratory has tested a sample assembly in accordance with NFPA 252 and issued a current listing for same.

SD-13 Certificates

Fire Rated Doors; G, RE

Thermal Insulated Doors; G, RE

a. Certification of Oversized Fire Doors: Certificates of compliance in accordance with the requirements of NFPA 252 for fire doors exceeding the sizes for which label service is available.

b. Certification of Thermal Insulating Rating: Certification or test report for thermal insulated doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6 mm airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

ANSI A250.8, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 44.5 mm thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 NOT USED

2.1.1.2 Heavy Duty Doors

ANSI A250.8, Level 2, physical performance Level B, Model 2, with core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation.

2.2 CUSTOM HOLLOW METAL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design, materials, construction, gages, and finish shall be as specified for standard steel doors and shall comply with the requirement of HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 1.5 mm thick. Close tops of exterior doors flush with an additional channel and seal to prevent water intrusion. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut doors where indicated. Doors shall be 44.5 mm thick, unless otherwise indicated.

2.3 INSULATED STEEL DOOR SYSTEMS

Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel not lighter than 0.7 mm thick, 1.5 mm thick, and 1.5 mm respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Doors and frames shall receive phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Doors shall have been tested in accordance with ANSI A250.4 and shall have met the requirements for Level C. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Doors shall be 44.5 mm thick.

2.4 NOT USED

2.5 ACCESSORIES

2.5.1 NOT USED

2.5.2 NOT USED

2.5.3 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710, "Door Hardware," provide overlapping steel astragals with the doors.

2.5.4 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.6 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI 113 and shall conform to:

a. Rigid Polyurethane Foam: ASTM C 591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

2.7 STANDARD STEEL FRAMES

ANSI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, and interior glazed panels, unless otherwise indicated.

2.7.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.7.2 NOT USED

2.7.3 NOT USED

2.7.4 Stops and Beads

Form stops and beads from 0.9 mm thick steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 300 to 400 mm on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.7.5 NOT USED

2.7.6 NOT USED

2.7.7 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick.

2.7.7.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more

than 2285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

2.7.7.2 Floor Anchors

Provide floor anchors drilled for 10 mm anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.8 FIRE DOORS AND FRAMES

NFPA 80 and this specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

2.8.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.8.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.8.3 Astragal on Fire Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements.

2.9 WEATHERSTRIPPING

As specified in Section 08710, "Door Hardware."

2.10 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of ANSI A250.8 and ANSI A250.6. For additional requirements refer to DHI A115.

Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.11 FINISHES

2.11.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in ANSI A250.8. Where coating is removed by welding, apply touchup of factory primer.

2.11.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior and interior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The Coating weight shall meet or exceed the minimum requirements for coatings having 122 grams per square meter, total both sides, i.e., ZF120. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in ANSI A250.8.

2.12 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 3 mm larger than the actual masonry thickness. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.12.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. In frames backfilled with mortar, and when an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC
Door thickness	1 3/4 inches	44.5 mm
Steel channels	16 gage	1.5 mm
Steel Sheet	23 gage	0.7 mm
	16 gage	1.5 mm
	20 gage	0.9 mm
	18 gage	1.2 mm
Anchor bolts	3/8 inches	10 mm

-- End of Section --

SECTION 08120

ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 605.2	(1992; Addendum 1995) High Performance Organic Coatings on Architectural Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997; Rev. A) Carbon Structural Steel
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Structural

Shapes and thicknesses of framing members shall be sufficient to withstand a design wind load of not less than 7 kilopascals of supported area with a deflection of not more than 1/175 times the length of the member. Provide glazing beads, moldings, and trim of not less than 1.25 mm nominal thickness. The glazing shall have a minimum frame bite of 25 mm. Frame connections to adjacent walls shall resist a combined ultimate loading consisting of a tension force of 35 KN/M and a shear force of 13-KN/M.

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 2.63 by 10-5 cms per square meter of fixed area at a test pressure of 0.30 kPa (80 kilometers per hour wind).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 0.38 kPa of fixed area.

1.2.4 Formability Test

In accordance with ASTM D 522, finish coating system shall show no microchecking of exterior film with no loss of adhesion, when subjected to 180-degree bend over 3 mm diameter mandrel and 10 mm diameter mandrel for coatings 0.10 mm or thicker.

1.2.5 Weathering Test

Sample of finished-coated sheet shall withstand weathering test for minimum of 2,000 hours in accordance with ASTM G 23 or ASTM G 26 without cracking, peeling, blistering, loss of adhesion of finish coating system or corrosion of base metal. Finish coating system that can be readily removed from base metal with penknife blade or similar instrument shall be considered to indicate loss of adhesion.

1.2.6 Chalking Resistance

After 2,000-hour weathering test, finish coating system shall not chalk less than No. 8 rating when measured in accordance with ASTM D 4214test procedures.

1.2.7 Color Change

After 3,000-hour weathering test, color change of finish coating system shall not exceed 5 NBS units when measured in accordance with ASTM D 2244 test procedures.

1.2.8 Specular Gloss

Finished surface shall have specular gloss value of 30 to 70 at angle of 60 degrees when measured in accordance with ASTM D 523.

1.2.9 Salt Spray Test

Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, coating shall receive a rating of few blisters, none larger than No. 8 in field as determined by ASTM D 714; and an average rating of 6, 3 mm failure at scribe, as determined by ASTM D 1654. Rating Schedule No. 1.

1.2.10 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968,

coating system shall withstand minimum of 50 liters of sand per mil of coating thickness before appearance of base metal.

1.2.11 Humidity Test

When subjected to humidity cabinet test in accordance with ASTM D 2247 for 1,000 hours, factory-finished, organic-coated panel shall show no signs of blistering, cracking, creepage, or corrosion with no loss of adhesion.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors and frames; G, RE

Show elevations of each door type, size of doors and frames, metal gages, details of door and frame construction, methods of anchorage, glazing details, weatherstripping, provisions for and location of hardware, and details of installation.

SD-03 Product Data

Aluminum Doors and Frames; G, RE

Manufacturer's descriptive data and catalog cuts including air-infiltration data.

SD-04 Samples

Finishes; G, RE

Samples of the color anodized coating, showing the extreme color range.

SD-06 Test Reports

Aluminum Doors

For full-glazed and flush doors, certified test reports from an independent testing laboratory, stating that doors are identical in design, materials, and construction to a door that has been tested and meets all test and specified requirements.

Formability test

Weathering test

Chalking resistance

Color change

Specular gloss

Salt spray test

Abrasion resistance test

Humidity test

Wind uplift

Submit reports performed by independent qualified testing laboratories.

SD-08 Manufacturer's Instructions

Doors and Frames; G, RE

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members, subframes, transoms, adjoining sidelights, adjoining window wall, trim, and accessories.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel or steel with hot-dipped galvanized finish.

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B 221M, Alloy 6063-T5 for extrusions. ASTM B 209M, alloy and temper

best suited for aluminum sheets and strips.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.2.5 Structural Steel

ASTM A 36/A 36M.

2.2.6 Aluminum Paint

Type as recommended by aluminum door manufacturer.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 300 mm o.c. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and not less than 45 mm thick. Minimum wall thickness, 3 mm, except beads and trim, 1.25 mm. Door sizes shown are nominal and shall include standard clearances as follows: 2.5 mm at hinge and lock stiles, 3 mm between meeting stiles, 3 mm at top rails, 5 mm between bottom and threshold, and 17 mm between bottom and floor. Bevel single-acting doors 3 mm at lock, hinge, and meeting stile edges. Double-acting doors shall have rounded edges at hinge stile, lock stile, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Doors shall have medium stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 10 or 13 mm diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 2.19 x 10-5 cubic meter per second of air per square meter of door area when tested in accordance with ASTM E 283.

2.3.5 Anchors

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Reinforce and anchor freestanding door frames to floor construction as indicated on approved shop drawings and in accordance with manufacturer's recommendation. Place anchors near top and bottom of each jamb and at intermediate points not more than 635 mm apart.

2.3.6 Provisions for Hardware

Hardware is specified in Section 08710, "Door Hardware." Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws.

2.3.7 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified. Glazing is specified in Section 08810, "Glass and Glazing."

2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of organic coating. Color shall match the color indicated on the drawings and in Section 09915R COLOR SCHEDULE.

2.3.8.1 NOT USED

2.3.8.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 605.2 with total dry film thickness of not less than 0.03 mm (1.2 mils). The finish color shall be in accordance with

Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, transoms, adjoining sidelights, and, adjoining window walls. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to rough floor construction with 2.4 mm thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Seal metal-to-metal joints between framing members as specified in Section 07900, "Joint Sealing." Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by one or a combination of the following methods:

a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.

c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.

d. Use a nonabsorptive tape or gasket in permanently dry locations.

3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint, to prevent aluminum discoloration.

3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum

paint and sealing the joints with elastomeric sealant.

3.3 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.4 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

-- End of Section --

SECTION 08210

WOOD DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 152	(1981; Rev. A) Fire Tests of Door Assemblies

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1997) Architectural Woodwork Quality Standards and Quality Certification Program

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
NFPA 252	(1995) Fire Tests of Door Assemblies

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

NWWDA I.S. 1-A	(1993) Architectural Wood Flush Doors
NWWDA TM-5	(1990) Split Resistance Test
NWWDA TM-7	(1990) Cycle - Slam Test
NWWDA TM-8	(1990) Hinge Loading Resistance Test

UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors; G, RE

Submit drawings or catalog data showing elevation of each type of door unit, location of each door, marks to be used to identify the doors, location and extent of blocking and descriptive data of head and jamb weatherstripping with installation instructions shall be included. Drawings and data shall indicate door type and construction, sizes and thickness.

Fire Doors; G, RE

Accessories

Water-resistant sealer; G, RE

Sample warranty

Fire resistance rating

Adhesives; G, RE

SD-04 Samples

Door finish colors

Factory-coated natural finish; G, RE

Samples of factory applied natural finish

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 100 mm thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.4 WARRANTY

Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicated.

2.1.1 NOT USED

2.1.2 Flush Doors

Flush doors shall conform to NWWDA I.S. 1-A. Hollow core doors shall have

lock blocks and 25 mm minimum thickness hinge stile. Stile edge bands of doors to receive natural finish shall be hardwood, compatible with face veneer. No visible finger joints will be accepted in stile edge bands. When used, locate finger joints under hardware.

2.1.2.1 NOT USED

2.1.2.2 Interior Flush Doors

Provide staved lumber core, Type II flush doors conforming to NWWDA I.S. 1-A with faces of premium grade natural birch. Hardwood veneers shall be rotary cut.

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 Composite-Type Fire Doors

Doors specified or indicated to have a fire resistance rating shall conform to the requirements of UL 10B, ASTM E 152, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

2.2 ACCESSORIES

2.2.1 NOT USED

2.2.2 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings except that moldings for doors to receive natural finish shall be of the same specie and color as the face veneers. Moldings for flush doors shall be lip type. Glazing is specified in Section 08810A, GLASS AND GLAZING.

2.2.3 Weatherstripping

Provide weatherstripping as specified in Section 08710 DOOR HARDWARE.

2.2.4 Additional Hardware Reinforcement

Provide fire rated doors with hardware reinforcement blocking. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be mineral material similar to the core.

2.3 FABRICATION

2.3.1 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door.

2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based, identify the standard under which preservative treatment was made, and identify doors having a Type I glue bond.

2.3.3 NOT USED

2.3.4 Adhesives and Bonds

NWWDA I.S. 1-A. Use Type I bond for exterior doors and Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

2.3.5 Prefitting

At the Contractor's option, doors may be provided factory pre-fit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, bevelling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

2.3.6 Finishes

2.3.6.1 NOT USED

2.3.6.2 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWI Qual Stds Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating shall be AWI Qual Stds premium, medium rubbed sheen, open grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.3.6.3 NOT USED

2.3.6.4 Color

Provide door finish colors as indicated in Section 09915, COLOR SCHEDULE.

2.3.7 Water-Resistant Sealer

Provide a water-resistant sealer compatible with the specified finish as approved and as recommended by the door manufacturer.

2.4 SOURCE QUALITY CONTROL

Stiles of "B" and "C" label fire doors utilizing standard mortise leaf hinges shall meet the following performance criteria:

a. Split resistance: Average of ten test samples shall be not less than 225 kilograms load when tested in accordance with NWWDA TM-5.

b. Cycle-slam: 200,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of NWWDA TM-7.

c. Hinge loading resistance: Average of ten test samples shall be not less than 315 kilograms load when tested for direct screw withdrawal in accordance with NWWDA TM-8 using a No. 12, 30 mm long, steel, fully threaded wood screw. Drill 4 mm pilot hole, use 40 mm opening around screw for bearing surface, and engage screw full, except for last 3 mm. Do not use a steel plate to reinforce screw area.

PART 3 EXECUTION

3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 2 mm minimum, 3 mm maximum clearance at sides and top, and a 5 mm minimum, 6 mm maximum clearance over thresholds. Provide 10 mm minimum, 11 mm maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 3 mm in 50 mm. Door warp shall not exceed 6 mm when measured in accordance with NWWDA I.S. 1-A.

3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

-- End of Section --

SECTION 08330A

OVERHEAD ROLLING DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip process
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM E 330	(1997el) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE Hdbk-IP	(1997) Handbook, Fundamentals I-P Edition
ASHRAE Hdbk-SI	(1997) Handbook, Fundamentals SI Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 80	(1999) Fire Doors and Fire Windows

1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Fire doors shall bear the Underwriters Laboratories, Warnock Hersey, Factory Mutual or other nationally recognized testing laboratory label for the rating listed on the drawings. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labelled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 5480 Pa. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. Test data showing compliance with design windload requirements for the specific door design tested in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested

1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overhead Rolling Door Unit; G, RE.

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power

operators, controls, and other fittings.

SD-03 Product Data

Overhead Rolling Door Unit; G, RE.

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

Overhead Rolling Door Unit

Manufacturer's preprinted installation instructions.

SD-04 Samples

Overhead Rolling Door Unit; G, RE.

Manufacturer's standard color samples of factory applied finishes.

SD-06 Test Reports

Tests; G, RE.

Written record of fire door drop test.

SD-07 Certificates

Fire Doors; G, RE.

Oversize labels or certificates stating that the overhead rolling doors conform to requirements of this section. Certificates for oversize fire doors stating that the doors and hardware are manufactured in compliance with the requirements for doors of this type and class and have been tested and meet the requirements for the class indicated. Certificate is not required when fire door has a listing agency label or oversize label on the door bottom bar.

SD-10 Operation and Maintenance Data

Operation Manual

Maintenance and Repair Manual

Six copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for

inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

PART 2 PRODUCTS

2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls.

2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 4.6 m wide shall be minimum bare metal thickness of 0.71 mm. Steel slats for doors from 4.6 to 6.4 m wide shall be minimum bare metal thickness of 0.87 mm. Steel slats for doors 6.4 m wide and wider shall be minimum bare metal thickness of 1.1 mm. Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above. Slats for fire doors over 3.6 m wide and under 6 m wide shall be not less than 0.87 mm steel. Slats for fire doors 6 m wide or wider shall be not less than 1.1 mm steel.

2.1.1.1 NOT USED

2.1.1.2 Insulated Curtains

The slat system shall supply a minimum R-value of 7 when calculated in accordance with ASHRAE Hdbk-IP ASHRAE Hdbk-SI. Slats shall be of the flat type as standard with the manufacturer. Slats shall consist of a polyurethane core not less than 17 mm thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as specified for curtains. Interior face shall be not lighter than 0.56 mm. The insulated slat assembly shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have steel endlocks of manufacturer's stock design. Endlocks shall be provided in accordance with manufacturer's listing on fire doors when required by test results performed by the code listing agency. In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.

2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors. A sensing edge shall be attached to the bottom bar of doors that are electric-power operated.

2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 2.5 mm per meter of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe. Aluminum plugs are acceptable on non-fire door barrels.

2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

2.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.56 mm formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment

and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

2.1.10 Slat Openings

2.1.10.1 Vision Lites

Vision lites shall be those standard for the manufacturer. The lite assembly shall consist of 3 separate lites across and 5 slats high. Opening shall have manufacturer's standard acrylic coverings.

2.1.11 Operation

Doors shall be operated by means of electric power with auxiliary chain hoist. Equipment shall be designed and manufactured for usage in non-hazardous areas.

2.1.11.1 NOT USED

2.1.11.2 NOT USED

2.1.11.3 NOT USED

2.1.11.4 Electric Power Operator With Auxiliary Chain Hoist Operation

Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, self-locking worm gear in oil bath for heavy-duty doors, brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator. Doors shall be provided with an auxiliary operator for immediate emergency manual operation of the door in case of electrical failure. Auxiliary operation shall be by means of galvanized endless chain extending to within 915 mm of the floor. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient wattage and torque output to move the door in either direction from any position at a speed range of 0.18 m per second (6 to 8 inches per second) without exceeding the rated capacity. Motors shall be suitable for operation on 208 volts, 60 hertz, 3-phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.

b. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), Type 7 or 9 in hazardous locations, in accordance with NFPA 70. Exterior control stations shall be weatherproof key-operated type with corrosion-resistant cast-metal cover. Each control station shall be of the three position button type, marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" controls shall be of the momentary contact type with seal-in contact. The "CLOSE" control shall be of the momentary contact type. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.

c. Sensing Edge Device: The bottom edge of electric power operated doors shall have a fail-safe electric sensing edge for non-hazardous areas that will reverse the door movement upon contact with an obstruction and cause the door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.

d. Electrical Work: Conduit and wiring necessary for proper operation shall be provided under Section 16415 ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70, as appropriate. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.

2.1.12 Inertia Brake

Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a failure in the motor operator brake or roller chain drive. The unit shall be capable of being reset with a back drive action.

2.1.13 Locking

Locking for motor operated doors shall consist of self-locking gearing with chain lock for emergency hand chain.

2.1.14 Finish

Steel slats and hoods shall be hot-dip galvanized G60 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on prime coat for field finishing. The paint system shall withstand a minimum of 1500 hours without blistering, bubbling, or rust. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.2 FIRE DOORS

Fire rated rolling doors shall be provided at locations shown on the drawings. Fire doors shall conform to the requirements specified herein and to NFPA 80 for the class indicated. Doors shall bear the label or oversize label, or be provided with oversize certification of a recognized testing agency indicating the listed rating for the fire door. The construction details necessary for the listed rating shall take precedence over conflicting details shown or specified herein. Fire doors shall be complete with hardware, accessories, and automatic closing device. An automatic closing device shall operate upon the fusing of a 74 degree C replaceable fusible link.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely. Fire doors shall be installed in conformance with the requirements of NFPA 80 and the manufacturer's instructions.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

3.3 TESTS

The fire doors shall be drop tested in accordance with NFPA 80 to show proper operation and full automatic closure and shall be reset in accordance with the manufacturer's instructions. A written record of initial test shall be provided to the Contracting Officer.

-- End of Section --

SECTION 08331A

METAL ROLLING COUNTER DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 240/A 240M	(1999b) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows

1.2 GENERAL

Rolling counter doors shall be of the type, size, and design indicated on the drawings, and shall be the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model number of the door.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, RE

Drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. A schedule showing the location of each counter door shall be included with the drawings.

SD-03 Product Data

Rolling Counter Doors; G, RE

Manufacturer's descriptive data and catalog cuts.

Installation; G, RE
Cleaning

Manufacturer's preprinted installation and cleaning instructions.

SD-10 Operation and Maintenance Data

Operation; G, RE

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed. Spare parts data for each different item of material and equipment specified shall be supplied not later than 30 days prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

1.4 DELIVERY AND STORAGE

Rolling counter doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Rolling counter doors shall be stored in accordance with the manufacturer's instructions in a dry location that is adequately ventilated and free from dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Doors shall be handled carefully to prevent damage. Damaged items that cannot be restored to like-new condition shall be replaced.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 BASIC COMPONENTS

2.1.1 Curtain

The curtain shall be fabricated, 22 gauge Type 304 stainless steel slats conforming to ASTM A 240/A 240M Thickness of slat material shall be as required by width of opening or as required by specified fire-rating. Slats shall be approximately 32 to 38 mm wide with a depth of crown of 13 mm. Alternate slats shall be fitted with end locks to maintain curtain alignment. Bottom of curtain shall be provided with angle or tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.

2.1.2 Jamb Guides

Guides shall be of 13 gauge minimum thickness stainless steel conforming to ASTM A 240/A 240M, Type 304.

2.1.3 Counterbalance Shaft Assembly

The curtain shall be coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 2.5 mm per meter. The barrel shall contain oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Springs shall be calculated to provide a minimum of 7,500 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

2.1.4 Brackets

Brackets shall be a minimum 12 gauge thickness steel if flat plate, or 16 gauge thickness if there are a minimum of 3 returns of 19 mm width.

2.1.5 Hood

The hood shall be of 24 gauge stainless steel conforming to ASTM A 240/A 240M, Type 304.

2.1.6 Locks

The curtain shall be locked at each side of the bottom bar by an integral slide bolt suitable for padlocks by others.

2.2 NOT USED

2.3 FIRE-RATED ROLLING COUNTER DOOR

Fire-rated rolling counter doors shall be rated as shown and shall conform to the requirements specified and to NFPA 80 for the class indicated. Doors shall bear the labels of a recognized testing agency indicating the applicable fire resistance rating. The construction details necessary for labeled rolling counter doors shall take precedence over details indicated or specified herein. Door curtains, guides and hood shall be stainless steel. Fire-rated rolling counter doors shall be complete with hardware, accessories, and automatic closing device. Rolling counter doors in exit corridor walls shall be provided with perimeter smoke and draft control gasketing.

2.4 NOT USED

2.5 OPERATION

2.5.1 Manual Operation

The curtain shall be operated by means of manual push-up with lift handles or continuous full width lift bar.

2.6 AUTOMATIC CLOSING DEVICE

Fire-rated counter doors shall be equipped with an automatic closing device which shall operate upon the fusing of a 74 degrees C fusible link and by activation of the building's fire alarm system and smoke alarm system. Fire and smoke doors shall be easily reset by the facility user after they have been released by the detection system. Resetting the door shall not require the use of special tools.

2.7 FINISH

Exposed parts of the counter door, including the curtain, bottom rail, guides, and hood shall be of uniform finish and appearance. Stainless steel shall have a No. 4 finish. All other steel parts shall be given a shop coat of primer paint standard with the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely. Fire-door installation shall be in conformance with NFPA 80 for the class indicated and the manufacturer's instructions.

3.2 NOT USED

3.3 CLEANING

Aluminum and stainless steel doors shall be cleaned in accordance with manufacturer's approved instructions.

3.4 TESTS

The fire doors shall be drop tested in accordance with NFPA 80 to show proper operation and full automatic closure and shall be reset in accordance with the manufacturer's instructions. A written record of initial test shall be provided to the Contracting Officer.

-- End of Section --

SECTION 08520A

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors
AAMA 605	(1998) voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1997el) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 547	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089	(1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(1997) Procedure for Determing Fenestration Product U-factors
NFRC 200	(1997) Procedure for Determining

	Fenestration Product Solar Heat Gain Coefficients at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(1997; Errata 97-1; TIA-97-1) Life Safety Code

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA 1004	(1987) Aluminum Tubular Frame Screens for Windows

1.2 WINDOW PERFORMANCE

Aluminum windows shall meet the following performance requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

Shapes and thicknesses of framing members shall be sufficient to withstand a design wind load of not less than 7 kilopascals of supported area with a deflection of not more than 1/160 times the length of the member. Provide glazing beads, moldings, and trim of not less than 1.25 mm nominal thickness. The glazing shall have a minimum frame bite of 25 mm. Frame connections to adjacent walls shall resist a combined ultimate loading consisting of a tension force of 35 KN/M and a shear force of 13-KN/M.

1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 547.

1.2.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows with insulating glass shall not exceed a U-factor of 4.3 W/m^2K (0.75 $Btu/hr\text{-}ft^2\text{-}F$) determined according to NFRC 100, and a solar heat gain coefficient (SHGC)

of 2.3 W/m^2K (0.40 $Btu/hr\text{-}ft^2\text{-}F$) determined according to NFRC 200. Window units shall comply with the U.S. Department of Energy, Energy Star Window Program for the Southern Climate Zone.

1.2.5 Condensation Index Rating

The condensation index rating shall be 95 as determined using NFRC approved software THERM.

1.2.6 Life Safety Criteria

Windows shall conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

1.2.7 Formability Test

In accordance with ASTM D 522, finish coating system shall show no microchecking of exterior film with no loss of adhesion, when subjected to 180-degree bend over 3 mm diameter mandrel and 10 mm diameter mandrel for coatings 0.10 mm or thicker.

1.2.8 Weathering Test

Sample of finished-coated sheet shall withstand weathering test for minimum of 2,000 hours in accordance with ASTM G 23 or ASTM G 26 without cracking, peeling, blistering, loss of adhesion of finish coating system or corrosion of base metal. Finish coating system that can be readily removed from base metal with penknife blade or similar instrument shall be considered to indicate loss of adhesion.

1.2.9 Chalking Resistance

After 2,000-hour weathering test, finish coating system shall not chalk less than No. 8 rating when measured in accordance with ASTM D 4214test procedures.

1.2.10 Color Change

After 3,000-hour weathering test, color change of finish coating system shall not exceed 5 NBS units when measured in accordance with ASTM D 2244 test procedures.

1.2.11 Specular Gloss

Finished surface shall have specular gloss value of 30 to 70 at angle of 60 degrees when measured in accordance with ASTM D 523.

1.2.12 Salt Spray Test

Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, coating shall receive a rating of few blisters, none larger than No. 8 in field as determined by ASTM D 714; and an average rating of 6, 3 mm failure at scribe, as determined by ASTM D 1654.

Rating Schedule No. 1.

1.2.13 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, coating system shall withstand minimum of 50 liters of sand per mil of coating thickness before appearance of base metal.

1.2.14 Humidity Test

When subjected to humidity cabinet test in accordance with ASTM D 2247 for 1,000 hours, factory-finished, organic-coated panel shall show no signs of blistering, cracking, creepage, or corrosion with no loss of adhesion.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Aluminum Windows; G, RE
Insect Screens; G, RE

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment, window cleaner anchor details, and window schedules showing locations of each window type.

SD-03 Product Data

Aluminum Windows; G, RE

Manufacturer's descriptive data and catalog cut sheets.

Aluminum Windows

Manufacturer's preprinted installation instructions and cleaning instructions.

SD-04 Samples

Aluminum Windows; G, RE

Manufacturer's standard color samples of the specified finishes.

SD-06 Test Reports

Aluminum Windows

Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph WINDOW PERFORMANCE.

Formability test

Weathering test

Chalking resistance

Color change

Specular gloss

Salt spray test

Abrasion resistance test

Humidity test

Wind uplift

Submit reports performed by independent qualified testing laboratories.

SD-07 Certificates

Aluminum Windows

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates. Product ratings determined using NFRC 100 and NFRC 200 shall be authorized for certification and properly labeled by the manufacturer.

1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.5 NOT USED

1.6 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be

replaced with new windows.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glass, frame, weatherstripping, and hardware. Windows shall conform to AAMA 101. Windows shall be thermal break type double-glazed. Thermal barrier shall be neoprene, rigid vinyl, or polyurethane and shall be resistant to weather. Window members shall be heli-arc welded or angle-reinforced and mechanically joined and sealed. Exposed welded joints shall be dressed and finished. Joints shall be permanent and weathertight. Frames shall be constructed to provide a minimum 6 mm thermal break between the exterior and interior frame surfaces. Sash corners shall be internally sealed to prevent air and water leaks. Inner sash shall be key-controlled to swing to the interior to allow maintenance and replacement of the glass. Not less than 4 control keys shall be furnished. The glazing shall have a minimum frame bite of 25 mm.

2.1.1 Awning/Hopper/Projected Windows

Aluminum awning (A), projected windows shall conform to AAMA 101 Designation PA-AW65 type consisting of hinged ventilators arranged in a single or vertical series within a common frame. Ventilators shall be equipped with concealed four-bar friction hinges. Operating hardware, except ventilator arms and rotary operators, shall be concealed within frame and sill. Ventilator arms shall be concealed when windows are closed.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 Fixed Windows

Aluminum fixed (F) windows shall conform to AAMA 101 F-AW60 type, non-operable glazed frame, complete with provisions for reglazing in the field.

2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA 101, and shall be manufactured of material compatible with aluminum and resistant to weather. Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

2.3 INSECT SCREENS

Insect screens shall be aluminum window manufacturer's standard design, and shall be provided where scheduled on drawings. Insect screens shall be fabricated of extruded tubular-shaped aluminum frames conforming to SMA 1004 and (18 x 16) aluminum mesh screening conforming with ISWA IWS 089, Type III.

2.4 ACCESSORIES

2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, non-magnetic stainless steel, cadmium-plated steel, nickel/chrome-plated steel in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 2 mm

2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel in accordance with requirements established by AAMA 101.

2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

2.5 GLASS AND GLAZING

Aluminum windows shall be designed for inside glazing, field glazing, and for glass types scheduled on drawings and specified in Section 08810 GLASS AND GLAZING. Units shall be complete with glass and glazing provisions to meet AAMA 101. Glazing material shall be compatible with aluminum, and shall not require painting.

2.6 FINISH

2.6.1 NOT USED

2.6.2 NOT USED

2.6.3 High-Performance Coating

Exposed surfaces of aluminum windows shall be finished with a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 605, with a primer coat of 0.005 to 0.008 mm (0.20 to 0.030 mils) and a color coat of minimum 0.025 mm (1.0 mils), total dry film thickness of 0.030 to 0.033 mm (1.2 to 1.3 mils). Finish shall be free of scratches and other blemishes.

2.6.4 Color

Color shall be in accordance with Section 09915R COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA 101. The completed window installation shall be watertight in accordance with Section 07900 JOINT SEALING. Glass and glazing shall be installed in accordance with requirements of this section and Section 08810 GLASS AND GLAZING.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

-- End of Section --

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	(1990) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(1997) Butts and Hinges (BHMA 101)
BHMA A156.2	(1996) Bored and Preassembled Locks and Latches (BHMA 601)
BHMA A156.3	(1994) Exit Devices (BHMA 701)
BHMA A156.4	(1992) Door Controls - Closers (BHMA 301)
BHMA A156.6	(1994) Architectural Door Trim (BHMA 1001)
BHMA A156.7	(1988) Template Hinge Dimensions
BHMA A156.8	(1994) Door Controls - Overhead Holders (BHMA 311)
BHMA A156.13	(1994) Mortise Locks & Latches (BHMA 621)
BHMA A156.15	(1995) Closer Holder Release Devices
BHMA A156.16	(1997) Auxiliary Hardware
BHMA A156.18	(1993) Materials and Finishes (BHMA 1301)
BHMA A156.21	(1996) Thresholds

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows

NFPA 101 (1997) Life Safety Code

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100 (1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1999) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Hardware schedule; G, RE

Keying system; G, RE

SD-03 Product Data

Hardware items; G, RE

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G, RE

SD-11 Closeout Submittals

Key bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

BHMA A156.1, 114 by 114 millimeters unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.2 NOT USED

2.3.3 NOT USED

2.3.4 Locks and Latches

2.3.4.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 178 by 57 mm with a bushing at least 6 mm long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws.

2.3.5 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide escutcheons, not less than 178 by 57 mm.

2.3.6 NOT USED

2.3.7 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have seven pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets shall have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.8 Keying System

Provide a master keying system. Provide a construction master keying system construction interchangeable cores. Provide key cabinet as specified.

2.3.9 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.9.1 Knobs and Roses

In addition to meeting test requirements of BHMA A156.2 and BHMA A156.13, knobs, roses, and escutcheons shall be 1.25 mm thick if unreinforced. If reinforced, outer shell shall be 0.89 mm thick and combined thickness shall be 1.78 mm, except knob shanks shall be 1.52 mm thick.

2.3.9.2 Lever Handles

Provide lever handles in lieu of knobs where specified in paragraph entitled "Hardware Schedule". Lever handles for exit devices shall meet the test requirements of BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 13 mm of the door face.

2.3.10 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish 5 master keys, 5 construction master keys, and 5 control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.11 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.

2.3.12 Closers

BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.12.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.13 Overhead Holders

BHMA A156.8.

2.3.14 Closer Holder-Release Devices

BHMA A156.15.

2.3.15 Door Protection Plates

BHMA A156.6.

2.3.15.1 Sizes of Mop and Kick Plates

Width for single doors shall be 50 mm less than door width; width for pairs of doors shall be 25 mm less than door width. Height of kick plates shall be 250 mm for flush doors. Height of mop plates shall be 150 mm.

2.3.16 NOT USED

2.3.17 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, six for each pair.

2.3.18 Padlocks

ASTM F 883.

2.3.19 Thresholds

BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.20 Weather Stripping

A set shall include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed 5.48 x 10-5 cms per minute of air per square meter of door area when tested in accordance with ASTM E 283. Weather stripping shall be one of the following:

2.3.20.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be clear (natural) anodized.

2.3.20.2 Interlocking Type

Zinc or bronze not less than 0.45 mm thick.

2.3.20.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.20 mm thick.

2.3.21 Lightproofing

A set shall include adjustable doorstops at head and jambs and an automatic door bottom, both of extruded aluminum, clear (natural) anodized, surface applied, with vinyl fin seals between plunger and housing. Doorstops shall have solid neoprene tube, silicone rubber, or closed-cell sponge gasket. Door bottoms shall have adjustable operating rod and silicone rubber or closed-cell sponge neoprene gasket. Doorstops shall be mitered at corners. Zero "Sound Stop 1" (No. 770 and No. 361); Pemko No. 350ASN and No. 430AS; National Guard No. 1038N and No. 420; or equal.

2.3.22 Rain Drips

Extruded aluminum, not less than 2.03 mm thick, clear anodized. Set drips in sealant conforming to Section 07900, "Joint Sealing," and fasten with stainless steel screws.

2.3.22.1 Door Rain Drips

Approximately 38 mm high by 16 mm projection. Align bottom with bottom edge of door.

2.3.22.2 Overhead Rain Drips

Approximately 38 mm high by 64 mm projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.23 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph entitled "Hardware Sets". Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 225 mm o.c. after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door 25 mm o.c. and to heads and jambs at 100 mm o.c.

3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 38 mm o.c.

3.1.2 Lightproofing Installation

Install as specified for stop-applied weather stripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

SDOI SDI-100, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

Hardware for aluminum doors shall be provided under this section. Deliver Hardware templates and hardware, except field-applied hardware to the aluminum door and frame manufacturer for use in fabricating the doors and frames.

SET #	QTY.	DESCRIPTION	MANUFACTURER	ORDER #	FINISH/COLOR
HW#1A	Door #: 101A				
	2EA	CONT. HINGE	HAGER	780-112HD-83"	628
	2EA	CLOSER	LCN	4111-SPQ CUSH	STANDARD POWDER-COAT ALUMINUM
	2EA	DOOR PULLS	SARGENT	813FLWDT	628
ACTIVE LEAF					
	1EA	MAGLOCK	MAGNALOCK	M62	
	1EA	DRESS COVER		DC62CL	
	1EA	HEADER BRACKET		UHB-CL	
	1EA	EXIT DEVICE	SECURITRON	TSB-3CL	
	1EA	CARD READER	HID CORP	5395	BLACK
INACTIVE LEAF					
	1EA	EXIT DEVICE	SARGENT	MD-8610F-LC	626

*WEATHERSTRIP AND ASTRAGAL BY DOOR MANUFACTURER

HW#1B	Door #: 102A				
	2EA	CONT. HINGE	HAGER	780-112HD-83"	628
	2EA	EXIT DEVICE	SARGENT	MD-8615F 813FLWDT	628
	2EA	CLOSER	LCN	4111-SPQ CUSH	STANDARD POWDER-COAT ALUMINUM

HW#2	Door #: 138A, 146A				
	1EA	LOCKSET	BEST ACCESS	35H7J14H	626
	3EA	BUTTS	McKINNEY	TA2714 114x114	652
	1EA	STOP	ROCKWOOD	401	626
	1EA	DOOR CLOSER	SARGENT	1431-P9	EN
	1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
	3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#3 Door #'s: 121A, 208A, 208B

1EA	LOCKSET	BEST ACCESS	35H7E14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#4 Door #'s: 122A, 123A, 124A, 125A, 126A, 127A, 128A, 129A, 130A, 209A, 210A, 211A, 212A, 213A, 214A, 215A, 216A, 217A, 218A, 219A, 220A, 221A, 222A, 224A, 225A, 244A, 245A, 246A, 247A, 248A, 250A, 251A, 252A, 253A, 255A, 256A, 257A

1EA	LOCKSET	BEST ACCESS	35H7E14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	COAT HOOK	PETER PEPPER	2081	AL

HW#5 Door #'s: 113A, 113B, 135A, 149A, 149B, 163A, 202A, 203A

1EA	LOCKSET	BEST ACCESS	35H7J14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	STOP	ROCKWOOD	401	626
1EA	DOOR CLOSER	SARGENT	281 P10	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#6 Door #'s: 111A, 111B, 111C, 113D, 120B, 139A, 150B, 178A, 178B, 178C, 178D, 105A-OMS, 105B-OMS, 101-UHS

3EA	BUTTS	McKINNEY	T4A3386 152x152	630
1EA	EXIT DEVICE	SARGENT	8910F	630
1EA	DOOR CLOSER	SARGENT	281 P10	EN
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW	630
1EA	THRESHOLD	NATIONAL GUARD	425-36"	ALUMINUM
1EA	SILL	NATIONAL GUARD	C627-36"	ALUMINUM
1SET	HEAD AND JAMB	NATIONAL GUARD	600A 1/34" x 2/84"	ALUMINUM

HW#7 Door #'s: 184A, 228A

3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	LOCKSET	BEST ACCESS	35H7N14H	626
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW	630

HW#8 Door #'s: 110A, 133B, 136A, 137A, 142A, 148A, 151A, 153A, 154A, 161A, 165A, 166A, 184B, 206B

1EA	LOCKSET	BEST ACCESS	35H7EW14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#9 Door #'s: 178E, 116A

3EA	BUTTS	McKINNEY	T4A3786 114x114	652

1EA	EXIT DEVICE	SARGENT	16-8904 ETL (ANSI FUNCTION 04)	630
1EA	DOOR CLOSER	SARGENT	281 P10	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	THRESHOLD	NATIONAL GUARD	425-36"	ALUMINUM
1EA	SILL	NATIONAL GUARD	C627-36"	ALUMINUM
1SET	HEAD AND JAMB	NATIONAL GUARD	600A-1/34" x 2/84"	ALUMINUM
1EA	CYLINDER	BEST ACCESS	1E74-C4-RP3	626

HW#10 Door #'s: 101B-OMS

3EA	BUTTS	McKINNEY	T4A3786 114x114	652
1EA	EXIT DEVICE	SARGENT	8915F ETL	630
1EA	DOOR CLOSER	SARGENT	281 P10	EN
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630

HW#11 Door #'s: 141A, 143A, 226A, 227A

3EA	BUTTS	McKINNEY	T4A3386 114x114	630
1EA	PUSH PLATE	ROCKWOOD	70E	630
1EA	PULL	ROCKWOOD	BF 107 x 70E	630
1EA	DOOR CLOSER	SARGENT	281-P10	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#12 Door #: 115A, 110A-OMS

6EA	BUTTS	McKINNEY	T4A3386 152x152	630
2EA	FLUSH BOLTS	ROCKWOOD	555	630
1EA	DOOR CLOSER	SARGENT	281 PSH	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW	630
1EA	THRESHOLD	NATIONAL GUARD	425-60"	ALUMINUM
1EA	SILL	NATIONAL GUARD	200NA-60"	ALUMINUM
1EA	WEATHERSTRIP	NATIONAL GUARD	600A-84"	ALUMINUM
1EA	WEATHERSTRIP	NATIONAL GUARD	600A-1/60" x 2/84"	ALUMINUM
1EA	LOCKSET	BEST ACCESS	35H7EW14H	626

HW#13 Door #: 243A

1EA	LOCKSET	BEST ACCESS	35H7J14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
1EA	STOP	ROCKWOOD	401	
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#14 Door #: 111D

6EA	BUTTS	McKINNEY	TA2714 114x114	652
2EA	DOOR CLOSER	SARGENT	1431-P9	EN
4EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
6EA	SILENCERS	GLYNN-JOHNSON	GJ66	
2EA	STOP	ROCKWOOD	401	626
2EA	EXIT DEVICE	SARGENT	12-PR8713Fx12-PP8713F ETL (ANSI FUNCTION 08)	630
2EA	CYLINDER	BEST ACCESS	1E74-C4-RP3	626

HW#15 Door #'s: 112A

1EA	LOCKSET	BEST ACCESS	35H7J14H	626
6EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
4EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
6EA	SILENCERS	GLYNN-JOHNSON	GJ66	
2EA	FLUSH BOLT	ROCKWOOD	550	630

HW#16 Door #'s: 159A, 160A, 171A, 172A, 111A-OMS

3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	LOCKSET	BEST ACCESS	35H7LF14H	626
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	COAT HOOK	PETER PEPPER	2081	AL

HW#17 Door #: 164A

1EA	LOCKSET	BEST ACCESS	35H7EW14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	THRESHOLD	NATIONAL GUARD	412	DKB
1EA	SILL	NATIONAL GUARD	420N	DKB
1SET	HEAD & JAMB	NATIONAL GUARD	1038N	DKB

HW#18 Door #'s: 121B, 134A, 155A, 208C, 223A, 238A

3EA	BUTTS	McKINNEY	TA2714 152X152	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	EXIT DEVICE	SARGENT	16-WD-8606F ETL (ANSI FUNCTION 03)	630
1EA	CYLINDER	BEST ACCESS	1E74-C4-RP3	626
1EA	STOP	ROCKWOOD	401	626

HW#19 DOOR #: 254A

6EA	BUTTS	McKINNEY	TA2714 152X152	652
2EA	DOOR CLOSER	SARGENT	1431-P9	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
6EA	SILENCERS	GLYNN-JOHNSON	GJ66	
2EA	EXIT DEVICE	SARGENT	12-PR8713Fx12-PP8713F ETL (ANSI FUNCTION 08)	630
2EA	CYLINDER	BEST ACCESS	1E74-C4-RP3	626
2EA	STOP	ROCKWOOD	401	626

HW#20 DOOR #: 186A, 189A, 103-UHS

3EA	BUTTS	McKINNEY	T4A3386 152X152	630
1EA	EXIT DEVICE	SARGENT	8904F ETL (ANSI FUNCTION 03)	630
1EA	DOOR CLOSER	SARGENT	281 P10	EN
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	THRESHOLD	NATIONAL GUARD	425-36"	ALUMINUM

1EA	SILL	NATIONAL GUARD	C627-36"	ALUMINUM
1SET	HEAD & JAMB	NATIONAL GUARD	6001-1/34" X 2/84"	ALUMINUM
1EA	CYLINDER	BEST ACCESS	1E74-C4-RP3	626

HW#21 DOOR #'S: 201A, 201B

3EA	BUTTS	McKINNEY	T4A3786 114X114	652
1EA	EXIT DEVICE	SARGENT	12-8915F ETL	630
1EA	DOOR CLOSER	SARGENT	281 P10	EN
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	ELECTRO-MAGNETIC HOLDER	SARGENT	1504	626

HW#22 DOOR #'S: 108A-OMS, 109A-OMS

3EA	BUTTS	McKINNEY	T4A3386 152X152	630
1EA	EXIT DEVICE	SARGENT	12-8904G ETL (ANSI FUNCTION 03)	630
1EA	DOOR CLOSER	SARGENT	281 P10	EN
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	THRESHOLD	NATIONAL GUARD	425-48"	ALUMINUM
1EA	SILL	NATIONAL GUARD	C627-48"	ALUMINUM
1SET	HEAD AND JAMB	NATIONAL GUARD	600A-1/46" x 2/84"	ALUMINUM
1EA	CYLINDER	BEST ACCESS	1E74-C4-RP3	626

HW#23 DOOR #: 249A

1EA	LOCKSET	BEST ACCESS	35H7E14H	626
6EA	BUTTS	McKINNEY	TA2714 114x114	652
2EA	STOP	ROCKWOOD	401	626
6EA	SILENCERS	GLYNN-JOHNSON	GJ66	
2EA	FLUSH BOLTS	ROCKWOOD	550 (INACTIVE LEAF)	630
1EA	CLOSER	SARGENT	1431-P9	EN

HW#24 DOOR #: 106A-OMS

1EA	LOCKSET	BEST ACCESS	35H7J14H	626
6EA	BUTTS	McKINNEY	T4A3786 152X152	652
2EA	DOOR CLOSER	SARGENT	281 P10	EN
2EA	FLUSHBOLT	ROCKWOOD	555 (INACTIVE LEAF)	630
6EA	SILENCERS	GLYNN-JOHNSON	GJ66	
4EA	KICKPLATE	ROCKWOOD	10" x 2" LDW x .050	630

HW#25 DOOR #: 107A-OMS

1EA	LOCKSET	BEST ACCESS	35H7EW14H	626
3EA	BUTTS	McKINNEY	T4A3786 114x114	652
1EA	DOOR CLOSER	SARGENT	281 P10	EN
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#26 DOOR #: 101A-OMS

3EA	BUTTS	McKINNEY	T4A3386 114x114	652
1EA	EXIT DEVICE	SECURITRON	TSB-3CL	
1EA	DOOR CLOSER	SARGENT	281 P10	EN
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	THRESHOLD	NATIONAL GUARD	425-36"	ALUMINUM

1EA	SILL	NATIONAL GUARD	C627-36"	ALUMINUM
1SET	HEAD AND JAMB	NATIONAL GUARD	600A-1/34" x 2/84"	ALUMINUM
1EA	MAGLOCK	MAGNALOCK	M62	
1EA	HEADER BRACKET		UHB-CL	
1EA	CARD READER	HID CORP	5395	BLACK

HW#27 DOOR #: 105A, 106A, 107A, 108A, 109A, 131A, 132A, 133A, 169A, 177A, 229A, 230A, 231A, 232A, 233A, 234A, 235A, 237A, 240A, 241A, 242A

1EA	LOCKSET	BEST ACCESS	35H7E14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	COAT HOOK	PETER PEPPER	2081	AL
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630

HW#28 DOOR #: 113C, 157A, 158A, 168A, 170A, 174A, 175A, 176A, 179A, 180A, 181A, 182A, 183A, 185A, 187A, 102A-OMS, 103A-OMS

1EA	LOCKSET	BEST ACCESS	35H7E14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	COAT HOOK	PETER PEPPER	2081	AL
2EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630

HW#29 DOOR #: 114A, 117A, 118A, 147A, 152A, 162A, 205A, 206A

1EA	LOCKSET	BEST ACCESS	35H7EW14H	626
3EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	

HW#30 DOOR #: 204A

1EA	LOCKSET	BEST ACCESS	35H7EW14H	626
6EA	BUTTS	McKINNEY	TA2714 114x114	652
1EA	DOOR CLOSER	SARGENT	1431-P9	EN
4EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630
6EA	SILENCERS	GLYNN-JOHNSON	GJ66	
2EA	FLUSH BOLT	ROCKWOOD	550	630

HW#31 Door #'s: 120A, 120C, 150A, 150C

3EA	BUTTS	McKINNEY	T4A3786 114x114	652
1EA	EXIT DEVICE	SARGENT	12-8915F ETL	630
1EA	DOOR CLOSER	SARGENT	281 P10	EN
1EA	STOP	ROCKWOOD	401	626
3EA	SILENCERS	GLYNN-JOHNSON	GJ66	
1EA	KICKPLATE	ROCKWOOD	10" x 2"LDW x .050	630

-- End of Section --

SECTION 08810A

GLASS AND GLAZING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 669	(1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 864	(1999) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1036	(1991; R 1997) Flat Glass
ASTM C 1048	(1997b) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 1172	(1996el) Laminated Architectural Flat Glass
ASTM D 395	(1998) Rubber Property - Compression Set
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 773	(1997) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774	(1997) Classification of the Durability of Sealed Insulating Glass Units
ASTM E 1300	(1998) Determining the Minimum Thickness

	and Type of Glass Required to Resist a Specified Load

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Safety Standard for Architectural Glazing Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-378	(Basic) Putty Linseed Oil Type, (for Wood-Sash-Glazing)

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(1997) Glazing Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 252	(1995) Fire Tests of Door Assemblies
NFPA 257	(1996) Fire Tests for Window and Glass Block Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G, RE

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Insulating Glass
Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Samples

Insulating Glass; G, RE

Two 203 x 254 mm samples of each of the following: tinted glass, and insulating glass units.

SD-07 Certificates

Insulating Glass

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

Glazing Accessories

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for heat absorbing glass.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE AND HANDLING

Glazing compounds shall be delivered to the site in the manufacturer's unopened containers. Glass shall be stored indoors in a safe, well ventilated dry location in accordance with manufacturer's instructions, and shall not be unpacked until needed for installation. Glass shall not be stored on site over 1 month.

1.5 PROJECT/SITE CONDITIONS

Glazing work shall not be started until outdoor temperature is above 5 degrees C and rising, unless procedures recommended by glass manufacturer and approved by Contracting Officer are made to warm the glass and rabbet surfaces. Ventilation shall be provided to prevent condensation of moisture on glazing work during installation. Glazing work shall not be performed during damp or raining weather.

1.6 WARRANTY

1.6.1 Insulating Glass

Manufacturer shall warrant the insulating glass to be free of fogging or film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by manufacturer.

1.6.2 Monolithic Reflective Glass

Manufacturer shall warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

1.6.3 Monolithic Opacified Spandrel

Manufacturer shall warrant the opacifier film on the spandrel to be free of peeling for a period of five years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

PART 2 PRODUCTS

2.1 FLOAT GLASS

2.1.1 Annealed Glass

Heat-strengthened annealed glass shall be Type I transparent flat type, Class 1 - tinted, Quality q3 - glazing select, conforming to ASTM C 1036. Color shall be as indicated in Section 09915 COLOR SCHEDULE.

2.1.2 NOT USED

2.1.3 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, .39 percent light transmittance, .36 percent shading coefficient, conforming to ASTM C 1036. Color shall be as indicated in Section 09915 COLOR SCHEDULE.

2.2 ROLLED GLASS

2.2.1 NOT USED

2.2.2 Wired Glass

Wired glass shall be 6 mm minimum thickness, Type II flat type, Class 1 - translucent, Quality q8 - glazing, Form 1 - wired and polished both sides. Wire mesh shall be polished stainless steel Mesh 1 - diamond. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for 45 minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252. Color shall be clear.

2.3 INSULATING GLASS

Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by an aluminum, steel, or stainless steel, spacer and dehydrated space conforming to ASTM E 773 and ASTM E 774. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the

secondary seal shall be a specially formulated silicone. Glass types shall be as follows:

2.3.1 NOT USED

2.3.2 NOT USED

2.3.3 Reflective Insulating Glass

Solar-reflective glass for reflective insulating units shall be Type I annealed flat type, Class 2-tinted glass with a mirror-like metallic or metallic-oxide highly reflective on the No. 2 (inside surface of outside pane) surface, Quality q3 - glazing select, conforming to ASTM C 1036. Glass performance shall be K-Value/Winter Nighttime 6.05, shading coefficient .52. Color shall be as indicated in Section 09915 COLOR SCHEDULE.

2.3.4 Low-E Insulating Glass

Interior glass panes for Low-E insulating units shall be Type I annealed flat glass, Class 1-clear with anti-reflective low-emissivity coating on No. 3 surface (outside surface of interior pane), Quality q3 - glazing select, conforming to ASTM C 1036. Glass performance shall be K-Value/Winter Nighttime 6.05, shading coefficient .52. Color shall be as indicated in Section 09915 COLOR SCHEDULE.

2.4 NOT USED

2.5 HEAT-TREATED GLASS

Heat-treated glass shall conform to the following requirements.

2.5.1 NOT USED

2.5.2 Heat-Strengthened Glass

Heat-strengthened glass shall be kind HS heat-strengthened transparent flat type, Class 2-tinted, Condition A uncoated surface, Quality q3 - glazing select, conforming to ASTM C 1048. Color shall be as indicated in Section 09915 COLOR SCHEDULE.

2.6 LAMINATED GLAZINGS

2.6.1 Laminated Glass

Laminated glass shall consist of two layers of Type I transparent float glass, Class 1-clear Quality q3 - glazing select, conforming to ASTM C 1036. Glass shall be bonded together with 0.76 mm thick PVB interlayer under pressure, or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C 1172. Color shall be clear.

2.7 SPANDREL GLASS

2.7.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass shall be kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 3 surface, Quality q3 - glazing select, conforming to ASTM C 1048. Glass performance shall be K-Value/Winter Nighttime 6.05, shading coefficient .52. Color shall be as indicated in Section 09915 COLOR SCHEDULE.

2.8 FIRE/SAFETY RATED GLASS

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a 60 minute rating when tested in accordance with ASTM E 119. Glass shall be permanently labeled with appropriate markings.

2.9 MIRRORS

2.9.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 6 mm (1/4 inch) thick conforming to ASTM C 1036. Glass color shall be clear. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 6 mm (1/4 inch) thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.9.2 NOT USED

2.9.3 Mirror Accessories

2.9.3.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.9.3.2 NOT USED

2.9.3.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

2.10 NOT USED

2.11 GLAZING ACCESSORIES

2.11.1 Preformed Tape

Preformed tape shall be elastomeric rubber extruded into a ribbon of a width and thickness suitable for specific application. Tape shall be of type which will remain resilient, have excellent adhesion, and be chemically compatible to glass, metal, or wood.

2.11.2 Sealant

Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass. Color of sealant shall be as selected from manufacturer's full range of colors.

2.11.3 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.11.3.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.11.3.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

2.11.3.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.11.4 Putty and Glazing Compound

Glazing compound shall conform to ASTM C 669 for face-glazing metal sash. Putty shall be linseed oil type conforming to CID A-A-378for face-glazing primed wood sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.11.5 Setting and Edge Blocking

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

Openings and framing systems scheduled to receive glass shall be examined for compliance with approved shop drawings, GANA Glazing Manual and glass manufacturer's recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be removed from glazing rabbet and glass surfaces and wiped dry with solvent. Glazing surfaces shall be dry and free of frost.

3.2 INSTALLATION

Glass and glazing work shall be performed in accordance with approved shop drawings, GANA Glazing Manual, glass manufacturer's instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Wired glass and fire/safety rated glass shall be installed in accordance with NFPA 80. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted.

3.3 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

-- End of Section --

SECTION 08900

GLAZED CURTAIN WALL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA 1	(1997) Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA MCWM-1	(1996) Metal Curtain Wall Manual
AAMA CW-10	(1997) Care and Handling of Architectural Aluminum from Shop to Site
AAMA 501	(1994) Exterior Walls
AAMA 610.1	(1979) Cleaning and Maintenance of Painted Aluminum Extrusions and Curtain Wall Panels
AAMA 800	(1992; Addenda 1994) Sealants

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(1997) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box

ASTM C 542	(1994) Lock-Strip Gaskets
ASTM C 864	(1998) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1048	(1997; Rev. B) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM E 34	(1994; R 1998) Chemical Analysis of Aluminum and Aluminum-Base Alloys
ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1997) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 546	(1988; R 1995) Frost Point of Sealed Insulating Glass Units
ASTM E 576	(1988; R 1995) Frost Point of Sealed Insulating Glass Units in the Vertical Position

AMERICAN WELDING SOCIETY (AWS)

AWS A5.10	(1992) Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods
AWS D1.1	(1998) Structural Welding Code - Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(1988) Metal Finishes Manual

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI 1001	(1996) Architectural Porcelain Enamel

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Glazed curtain wall system; G, RE

Submit for curtain wall system, accessories, and mock-up. Tentative approval of drawings shall be received before fabrication of mock-up. Final approval of drawings will be deferred pending approval of mock-up and accessories. Drawings shall indicate in detail all system parts including elevations, full-size sections, framing, jointing, panels, types and thickness of metal, flashing and coping details, field connections, weep and drainage system, finishes, sealing methods, glazing, glass sizes and details, firestopping insulation materials, and erection details.

SD-03 Product Data

Glazed curtain wall system; G, RE

Include descriptive literature, detailed specifications, and available performance test data.

SD-05 Design Data

Calculations; G, RE

SD-06 Test Reports

Formability test

Weathering test

Chalking resistance

Color change

Specular gloss

Salt spray test

Abrasion resistance test

Humidity test

Wind uplift

Submit reports performed by independent qualified testing laboratories.

SD-08 Manufacturer's Instructions

Glazed curtain wall system

Insulating glass

1.3 REQUIREMENT FOR DESIGN DATA

Submit structural and thermal calculations for complete wall assembly.

1.4 QUALITY ASSURANCE

1.4.1 Testing Requirements

The components listed below shall have been tested in accordance with the requirements below, and shall meet performance requirements specified.

a. Joint and Glazing Sealants: Perform tests as required by applicable publications referenced.

b. Preformed Compression Gaskets and Seals: ASTM C 864.

c. Preformed Lock-strip Gaskets: ASTM C 542, modified as follows: Heat age specimens seven days at 70 degrees C, in zipped or locked position under full design compression. Unzip, cool for one hour, re-zip, and test lip seal pressure, which shall be minimum 0.045 kilograms per linear millimeter on any extruded or corner specimen.

d. Spandrel Glass: Fallout resistance test, ASTM C 1048.

e. Porcelain Enamel: Acid resistance, color retention, and spall resistance tests, PEI 1001.

f. Insulating Glass: ASTM E 546 or ASTM E 576 at minus 29 degrees C, no frost or dew point.

1.4.2 NOT USED

1.4.3 Factory Tests

Perform the following tests except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested, under the conditions specified herein, the resulting test reports may be submitted in lieu of testing the components listed below:

a. Deflection and Structural Tests

b. Water Penetration Test

c. Air Infiltration Test

d. Thermal Conductance Tests

e. Window Tests

1.4.3.1 Deflection and Structural Tests

Shapes and thicknesses of framing members shall be sufficient to withstand

a design wind load of not less than 7 kilopascals of supported area with a deflection of not more than 1/175 times the length of the member. No framing member shall have a permanent deformation in excess of 0.2 percent of its clear span when tested in accordance with ASTM E 330 for a minimum test period of 10 seconds at 1.5 times the design wind pressures specified. Provide glazing beads, moldings, and trim of not less than 1.25 mm nominal thickness. The glazing shall have a minimum frame bite of 25 mm. Frame connections to adjacent walls shall resist a combined ultimate loading consisting of a tension force of 35 KN/M and a shear force of 13-KN/M.

1.4.3.2 Water Penetration Test

No water penetration shall occur when the wall is tested in accordance with ASTM E 331 at a differential static test pressure of 20 percent of the inward acting design wind pressure as specified, but not less than 0.19 kPa. Make provision in the wall construction for adequate drainage to the outside of water leakage or condensation that occurs within the outer face of the wall. Leave drainage and weep openings in members and wall open during test.

1.4.3.3 Air Infiltration Test

Air infiltration through the wall, when tested in accordance with ASTM E 283, shall not exceed 0.005 cms per sq. m of fixed wall area, plus the permissible allowance specified for operable windows within the test area.

1.4.3.4 NOT USED

1.4.3.5 Thermal Conductance Tests

The thermal transmittance of opaque panels shall not exceed specified U-value, when tested in accordance with ASTM C 236. The average calculated thermal transmittance of the complete wall assembly including panels, windows, and all other components shall not exceed a RSI value of 0.287. Determine U-values of components in accordance with ASTM C 236.

1.4.3.6 Window Tests

Windows shall meet the requirements specified in Section 08520A, except where the requirements of this section differ, this section shall govern. Windows shall meet the same requirements for deflection and structural adequacy as specified for framing members when tested in accordance with ASTM E 330 except permanent deformation shall not exceed 0.4 percent; there shall be no glass breakage, and no permanent damage to fasteners, anchors, hardware, or operating devices. Windows shall have no water penetration when tested in accordance with ASTM E 331.

1.4.3.7 Formability Test

In accordance with ASTM D 522, finish coating system shall show no microchecking of exterior film with no loss of adhesion, when subjected to 180-degree bend over 3 mm diameter mandrel and 10 mm diameter mandrel for coatings 0.10 mm or thicker.

1.4.3.8 Weathering Test

Sample of finished-coated sheet shall withstand weathering test for minimum of 2,000 hours in accordance with ASTM G 23 or ASTM G 26 without cracking, peeling, blistering, loss of adhesion of finish coating system or corrosion of base metal. Finish coating system that can be readily removed from base metal with penknife blade or similar instrument shall be considered to indicate loss of adhesion.

1.4.3.9 Chalking Resistance

After 2,000-hour weathering test, finish coating system shall not chalk less than No. 8 rating when measured in accordance with ASTM D 4214test procedures.

1.4.3.10 Color Change

After 3,000-hour weathering test, color change of finish coating system shall not exceed 5 NBS units when measured in accordance with ASTM D 2244 test procedures.

1.4.3.11 Specular Gloss

Finished surface shall have specular gloss value of 30 to 70 at angle of 60 degrees when measured in accordance with ASTM D 523.

1.4.3.12 Salt Spray Test

Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, coating shall receive a rating of few blisters, none larger than No. 8 in field as determined by ASTM D 714; and an average rating of 6, 3 mm failure at scribe, as determined by ASTM D 1654. Rating Schedule No. 1.

1.4.3.13 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, coating system shall withstand minimum of 50 liters of sand per mil of coating thickness before appearance of base metal.

1.4.3.14 Humidity Test

When subjected to humidity cabinet test in accordance with ASTM D 2247 for 1,000 hours, factory-finished, organic-coated panel shall show no signs of blistering, cracking, creepage, or corrosion with no loss of adhesion.

1.5 GLAZED CURTAIN WALL SYSTEM REQUIREMENTS

Provide system complete with framing, mullions, trim, framed pre-assembled units, glass, glazing, sealants, fasteners, anchors, accessories, concealed auxiliary members, and attachment devices for securing the wall to the structure as specified or indicated.

1.5.1 Source

Curtain wall system components shall be furnished by one manufacturer or fabricator; however, all components need not be products of the same manufacturer.

1.5.2 Design

Tubular aluminum sections with self supporting framing, factory prefinished, vision glass, related flashings, anchorage, and attachment devices. Mullion profile, horizontal and vertical members, shall be minimum 190 by 56.25 mm nominal dimensions or as indicated on the drawings, thermally broken with interior section insulated from exterior section; matching stops and pressure plate of sufficient size and strength to provide a 25 mm bite on 25 mm insulated laminated glass; drainage holes, deflector plates and internal flashings to accommodate internal weep drainage system, internal mullion baffles to eliminate 'stack effect' air movement within internal spaces. Fully coordinate system accessories directly incorporated, and adjacent to contiguous related work and insure materials compatibility, deflection limitations, thermal movements, and clearances and tolerances as indicated or specified.

1.5.3 Thermal Movement

Fabricate, assemble, and erect system with adequate allowances for expansion and contraction of components and fastenings to prevent buckling damage, joint seal failure, glass breakage, undue stress on fastenings or other detrimental effects. For design purposes, base provisions for thermal movement on assumed ambient temperature range of from 95 degrees C over a 12-hour period.

1.5.4 Tolerances

Design and erect wall system to accommodate tolerances in building frame and other contiguous work as indicated or specified. Provide with the following tolerances:

a. Maximum variation from plane or location shown on approved shop drawings: one millimeter per 12 meters of length up to not more than 13 mm in any total length.

b. Maximum offset from true alignment between two identical members abutting end to end in line: 2 mm.

1.5.5 Structural Requirements

No member shall deflect in a direction parallel to the plane of the wall, when carrying its full design load, more than an amount which will reduce the edge cover or glass bite below 75 percent of the design dimension. No member after deflection under full design load, shall have a clearance between itself and the top of the panel, glass, sash, or other part immediately below it less than 3 mm; the clearance between the member and an operable window or door shall be minimum 2 mm. Design entire system to

withstand the indicated wind and concentrated loads, and the following wind loads acting normal to the plane of the wall:

a. On the first 2 stories above grade 7 kPa acting inward, and the same load acting outward.

b. On corner areas, extending 3 meters from the building corners, on all facades, the outward-acting (negative) design load shall be 7 kilopascals.

1.6 QUALIFICATION OF WELDERS

Welding shall be performed by certified welders qualified in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.7 DELIVERY AND STORAGE

Inspect materials delivered to the site for damage; unload and store with a minimum of handling in accordance with recommendations contained in AAMA CW-10. Storage spaces shall be dry locations with adequate ventilation, free from heavy dust, not subject to combustion products or sources of water, and shall permit easy access for inspection and handling. Deliver calking and sealing compounds to the job site in sealed containers labeled to show the designated name, formula or specifications number; lot number; color; date of manufacturer; shelf life; and curing time when applicable.

1.7.1 Protective Covering

Prior to shipment from the factory, place knocked-down lineal members in cardboard containers and cover finished surfaces of aluminum with protective covering of adhesive paper, waterproof tape, or strippable plastic. Covering shall not chip, peel, or flake due to temperature or weather, shall protect against discoloration and surface damage from transportation, and storage, and shall be resistant to alkaline mortar and plaster. Do not cover aluminum surfaces that will be in contact with sealants after installation.

1.7.2 Identification

Prior to delivery, mark wall components to correspond with shop and erection drawings placement location and erection.

1.8 WARRANTY

Insulating glass units shall be guaranteed not to develop material obstruction of vision as a result of dust or film formation on the inner glass surface caused by failure of the seal, other than through glass breakage, within a period of 5 years from date of acceptance of work by the Government. Units failing to comply with the terms of this guarantee shall be replaced with new units without additional cost to the Government. The Contractor shall require the manufacturer to execute their warranties in writing directly to the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum

Shall be free from defects impairing strength or durability of surface finish. Standard alloys shall conform to standards and designations of AA 1. Special alloys, not covered by the following ASTM specifications, shall conform to standards and designations recommended by the manufacturer for the purpose intended.

2.1.1.1 Wrought Aluminum Alloys

Shall be those which include aluminum alloying elements not exceeding the following maximum limits when tested and additional in accordance with ASTM E 34. These limits apply to both bare products and the core of clad products. The cladding of clad products shall be within the same limits except that the maximum zinc limit may be 2.5 percent in order to assure that the cladding is anodic to the core. Special wrought alloys with a silicon content not more than 7.0 percent will be acceptable for limited structural uses where special appearance is required:

ALLOY	PERCENT
Silicon	1.5
Magnesium, Manganese, and Chromium combined	6.0
Iron	1.0
Copper	0.4
Zinc	1.0

Within the chemical composition limits set forth above, wrought aluminum alloys shall conform to the following:

a. Extruded bars, rods, shapes and tubes: ASTM B 221M.

b. Sheet and Plate: ASTM B 209M.

2.1.1.2 NOT USED

2.1.1.3 Welding Rods and Electrodes

Welding rods and bare electrodes shall conform to AWS A5.10 as recommended by the manufacturer of the aluminum base metal alloy being used.

2.1.1.4 Finish

High performance finish on aluminum surfaces shall match in appearance or fall within the two extremes of color range of the approved samples. The

following designation of finishes refer to standard finishes as defined in the NAAMM AMP 500. Aluminum used for framing shall have a high-performance finish in accordance with AAMA 605.2 with total dry film thickness not less than 0.03 mm (1.2 mils). The finish color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 Metal Fasteners

Provide fasteners as specified in paragraph entitled "Fastener Metals for Joining Various Metal Combinations" in "Part 2 - Products" of the AAMA MCWM-1. Metals used for fasteners shall be chemically and galvanically compatible with contiguous materials.

2.1.9 NOT USED

2.1.10 Joint Sealants and Accessories

Provide manufacturer's standard colors as closely matching the adjacent surfaces as possible.

2.1.10.1 Elastomeric, Single or Multiple Component

ASTM C 920, Type S, single component. Use Grade NS, nonsag type in joints on vertical surfaces and use Grade P, self-leveling or flow type, in joints on horizontal surfaces.

2.1.10.2 Single Component Silicone Rubber Base

ASTM C 920, Type S, Grade NS (Silicone).

2.1.10.3 Solvents and Primers

Provide material which is quick drying, colorless, nonstaining, compatible with compound used, as recommended by sealant manufacturer. Where primer is specified or recommended by sealant manufacturer, tests related to that material shall include primer.

2.1.10.4 Backing Material

Provide material which is nonstaining, nonabsorbent, and compatible with sealing compound. Closed cell resilient urethane, polyvinylchloride or polyethylene foam; closed-cell sponge of vinyl or rubber; closed cell

neoprene or butyl rod; or polychloroprene tubes or beads.

2.1.10.5 Bond Preventive Materials

Provide polyethylene tape with pressure-sensitive adhesive; aluminum foil or waxed paper.

2.1.10.6 Preformed Sealing Compound

Provide nonskinning type conforming to AAMA 800. Tapes, beads, ribbons or other shapes as required.

2.1.11 Glass and Glazing

Materials are specified under Section 08810A, GLASS AND GLAZING.

2.1.11.1 Glass Sizes and Clearances

Sizes indicated are nominal. Verify actual sizes required by measuring frames. Coordinate dimensions for glass and glass holding members to meet applicable minimum clearances as recommended by glass manufacturer. Do not nip to remove flares or to reduce oversized dimensions.

2.1.11.2 NOT USED

2.1.11.3 NOT USED

2.1.11.4 NOT USED

2.1.11.5 NOT USED

2.1.11.6 Glass Setting Materials

a. Sealants and preformed sealing compounds: Shall be as specified under paragraph entitled "Joint Sealant and Accessories."

2.1.12 NOT USED

2.1.13 NOT USED

2.1.14 NOT USED

2.1.15 NOT USED

2.1.16 NOT USED

2.1.17 NOT USED

2.1.18 NOT USED

2.1.19 Metal Accessories

Flashings, metal sills, metal stops. Fabricate accessories of sizes and shapes indicated from similar materials and finish as specified for wall

system.

PART 3 EXECUTION

3.1 FABRICATION

The curtain wall components shall be of the materials and thickness indicated or specified. The details indicated are representative of the required design and profiles. Acceptable designs may differ from that shown if the proposed system components conform to the limiting dimensions indicated and the requirements specified herein. Unless specifically indicated or specified otherwise, the methods of fabrication and assembly shall be at the discretion of the curtain wall manufacturer. Perform fitting and assembling of components in the shop to the maximum extent practicable. Anchorage devices shall permit adjustment in three directions. Exposed fastenings used on finished surfaces shall be truss head, flat head, or oval head screws or bolts.

3.1.1 Joints

Provide welded or mechanical fasteners as indicated or specified. Match joints in exposed work to produce continuity of line and design. Bed-joints or rabbets receiving calking or sealing material shall be minimum 20 mm deep and 10 mm wide at mid ambient temperature range.

3.1.2 Welding

Conform to AWS D1.1. Use methods and electrodes recommended by manufacturers of base metal alloys. Welding rods shall be of an alloy that matches the color of the metal being welded. Protect glass and other finish from exposure to welding spatter. Ground and finish weld beads on exposed metal surfaces to minimize mismatch and to blend with finish on adjacent parent metal. If flux is used in welding aluminum, completely remove it immediately upon completion of welding operations. Do not use exposed welds on aluminum surfaces.

3.1.3 Soldering and Brazing

Provide as recommended by suppliers. Solder only for filling or sealing joints.

3.1.4 Ventilation and Drainage

Provide internal ventilation drainage system of weeps or based on principles of pressure equalization to ventilate the wall internally and to discharge condensation and water leakage to exterior as inconspicuously as possible. Flashings and other materials used internally shall be nonstaining, noncorrosive, and nonbleeding.

3.1.5 Protection and Treatment of Metals

3.1.5.1 General

Remove from metal surfaces lubricants used in fabrication and clean off

other extraneous material before leaving the shop.

3.1.5.2 Galvanic Action

Provide protection against galvanic action wherever dissimilar metals are in contact, except in the case of aluminum in permanent contact with galvanized steel, zinc, stainless steel, or relatively small areas of white bronze. Paint contact surfaces with one coat bituminous paint or apply appropriate calking material or nonabsorptive, noncorrosive, and nonstaining tape or gasket between contact surfaces.

3.1.5.3 Protection for Aluminum

Protect aluminum which is placed in contact with, built into, or which will receive drainage from masonry, lime mortar, concrete, or plaster with one coat of alkali-resistant bituminous paint. Where aluminum is contacted by absorptive materials subject to repeated wetting or treated with preservative noncompatible with aluminum, apply two coats of aluminum paint, to such materials and seal joints with approved calking compound.

3.2 INSTALLATION

Installation and erection of glazed wall system and all components shall be performed under direct supervision of and in accordance with approved recommendations and instructions of wall system manufacturer or fabricator.

3.2.1 Bench Marks and Reference Points

Establish and permanently mark bench marks for elevations and building line offsets for alignment at convenient points on each floor level. Should any error or discrepancy be discovered in location of the marks, stop erection work in that area until discrepancies have been corrected.

3.2.2 Verifying Conditions and Adjacent Surfaces

After establishment of lines and grades and prior to system installation examine supporting structural elements. Verify governing dimensions, including floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frames, and other permissible dimensional tolerances in the building frame.

3.2.3 NOT USED

3.2.4 NOT USED

3.2.5 Joint Sealants

3.2.5.1 Surface Preparation

Surfaces to be primed and sealed shall be clean, dry to the touch, free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter. Enclose joints on three sides. Clean out grooves to proper depth. Joint dimensions shall conform to approved detail drawings with a tolerance of plus 3 mm. Do not apply compound unless ambient temperature is between

4 and 32 degrees C. Clean out loose particles and mortar just before sealing. Remove protective coatings or coverings from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings shall be of type that leave no residue on metals.

3.2.5.2 Applications

Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound shall be uniformly smooth and free of wrinkles and, unless indicated otherwise, shall be tooled and left sufficiently convex to result in a flush joint when dry. Do not trim edges of sealing material after joints are tooled. Mix only amount of multi-component sealant which can be installed within four hours, but at no time shall this amount exceed 19 liters.

3.2.5.3 Primer

Apply to masonry, concrete, wood, and other surfaces as recommended by sealant manufacturer. Do not apply primer to surfaces which will be exposed after calking is completed.

3.2.5.4 Backing

Tightly pack in bottom of joints which are over 13 mm in depth with specified backing material to depth indicated or specified. Roll backing material of hose or rod stock into joints to prevent lengthwise stretching.

3.2.5.5 Bond Prevention

Install bond preventive material at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavities.

3.2.5.6 Protection and Cleaning

Remove compound smears from surfaces of materials adjacent to sealed joints as the work progresses. Use masking tape on each side of joint where texture of adjacent material will be difficult to clean. Remove masking tape immediately after filling joint. Scrape off fresh compound from adjacent surfaces immediately and rub clean with approved solvent. Upon completion of calking and sealing, remove remaining smears, stains, and other soiling, and leave the work in clean neat condition.

3.2.6 Glass

Install in accordance with manufacturer's recommendations as modified herein.

3.2.6.1 Inspection of Sash and Frames

Before installing glass, inspect sash and frames to receive glass for defects such as dimensional variations, glass clearances, open joints, or other conditions that will prevent satisfactory glass installation. Do not proceed with installation until defects have been corrected.

3.2.6.2 Preparation of Glass and Rabbets

Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying glazing compound, sealing compound, glazing tape, or gaskets. Use only approved solvents and cleaning agents recommended by compound or gasket manufacturer.

3.2.6.3 Positioning Glass

Set glass from inside the building unless otherwise indicated or specified. Maintain specified edge clearances and glass bite at perimeter. Maintain position of glass in rabbet and provide required sealant thickness on both sides of glass. For glass dimensions larger than 1270 united millimeters, provide setting blocks at sill and spacer shims on all four sides; locate setting blocks one quarter way in from each jamb edge of glass. Where setting blocks and spacer shims are set into glazing compound or sealant, butter with compound or sealant, place in position, and allow to firmly set prior to installation of glass.

3.2.6.4 Setting Methods

Install glass in accordance with Section 08810 GLASS AND GLAZING to glazing method required to achieve performance criteria.

3.2.6.5 Void Space

Heat absorbing, insulating, spandrel, and tempered glass, and glass of other types that exceed 2540 united millimetersin size: Provide void space at head and jamb to allow glass to expand or move without exuding the sealant.

3.2.6.6 Insulating Glass

Provide adequate means to weep incidental water and condensation away from the sealed edges of insulated glass units and out of the wall system. The weeping of lock-strip gaskets should be in accordance with the recommendation of the glass manufacturer.

3.2.6.7 Insulating Glass With Edge Bands

Insulating glass with flared metal edge bands set in lock-strip type gaskets: Follow glass manufacturer's recommendations and add supplementary wet seal as required; when used with glazing tape, use tapered tape.

3.3 FINISHES

3.3.1 Galvanizing

Conform to ASTM A 123/A 123M, ASTM A 153/A 153M, and ASTM A 653/A 653M, as applicable.

3.3.1.1 Repair of Zinc-Coated Surfaces

Repair zinc coated surfaces damaged by welding or other means with galvanizing repair paint or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved.

3.3.2 Shop Cleaning and Painting

3.3.2.1 Cleaning

Clean steel and iron work by power wire brushing or other approved manual or mechanical means, for removal of rust, loose paint, scale, and deleterious substances. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other foreign matter, with solvents until thoroughly clean. Cleaning steel embedded in concrete is not required.

3.4 FIELD TESTS

Conduct field check test for water leakage on designated wall areas after erection. Conduct test on two wall areas, two bays wide by two stories high where directed. Conduct test and take necessary remedial action as described in AAMA 501.

3.5 CLEANING AND PROTECTION

3.5.1 Glass

Upon completion of wall system installation, thoroughly wash glass surfaces on both sides and remove labels, paint spots, putty, compounds, and other defacements. Replace cracked, broken, and defective glass with new glass at no additional cost to the Government.

3.5.2 Aluminum Surfaces

Protection methods, cleaning, and maintenance shall be in accordance with AAMA 609 and AAMA 610.1.

3.5.3 Other Metal Surfaces

After installation, protect windows, panels, and other exposed surfaces from disfiguration, contamination, contact with harmful materials, and from other construction hazards that will interfere with their operation, or damage their appearance or finish. Protection methods shall be in accordance with recommendations of product manufacturers or of the respective trade association. Remove paper or tape factory applied protection immediately after installation. Clean surfaces of mortar, plaster, paint, smears of sealants, and other foreign matter to present neat appearance and prevent fouling of operation. In addition, wash with a stiff fiber brush, soap and water, and thoroughly rinse. Where surfaces become stained or discolored, clean or restore finish in accordance with recommendations of product manufacturer or the respective trade association.

-- End of Section --

SECTION 09100N

METAL SUPPORT ASSEMBLIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(1997; Rev. A) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	(1998) Nonstructural Steel Framing Members
ASTM C 754	(1997) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Metal support systems; G, RE

Submit for the erection of metal framing, furring, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

SD-07 Certificates

Metal support systems; G, RE

Certificates stating that the metal support system meets the specified requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on

a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A 653/A 653M, Z180; aluminum coating ASTM A 463/A 463M, T1-75 ; or a 55-percent aluminum-zinc coating.

2.1.1 Materials for Attachment of Gypsum Wallboard

2.1.1.1 Suspended and Furred Ceiling Systems

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 1.40 mm thick cold-rolled steel, 38 x 19 mm. Furring members shall be formed from cold-rolled steel, 22 x 65 mm. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

2.1.1.2 Nonload-Bearing Wall Framing and Furring

Studs for non-loadbearing walls shall conform to ASTM C 645, but not thinner than 0.69 mm thickness, with 0.85 mm minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures. Studs shall be C-shaped, roll formed steel made from G40 hot-dip galvanized coated sheet.

2.1.1.3 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped with minimum 25 mm flanges, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Gypsum Wallboard

3.1.1.1 Suspended Ceiling Framing

ASTM C 754, except that framing members shall be 400 mm o.c. unless indicated otherwise.

3.1.1.2 Interior Wall Framing

Steel framing and furring members shall be installed in accordance with ASTM C 754. Members shall be in alignment with spacings not to exceed the maximum spacings indicated on drawings. Runners shall be aligned accurately at the floor and ceiling and securely anchored.

3.1.1.3 Wall Openings

The framing system shall provide for the installation and anchorage of the required subframes or finish frames for wall openings at doors, pass-through openings, and access panels. Partitions abutting continuous suspended ceilings shall be strengthened for rigidity at rough openings of more than 750 mm wide. Studs at openings shall be 0.85 mm (0.0329 in) minimum bare metal thickness and spot grouted at jamb anchor inserts. Double studs shall be fastened together with screws and secured to floor and overhead runners. Two studs shall be used for framing solid-core doors, doors over 900 mm wide and extra-heavy doors.

3.1.1.4 Hangers

Hangers shall be spaced not more than 1200 mm along runner channels and 900 mm in the other direction or 1050 mm in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 150 mm from wall. Hanger wire shall be looped around bottom chord of open-web steel joists, or secured to structural elements with suitable fasteners. Sags or twists which develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

3.1.1.5 Main Runners

Main runner channels shall be installed in accordance with ASTM C 754. Hanger wires shall be double strand saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 150 mm of the paralleling wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 300 mm with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.

3.1.1.6 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 754. Furring channels shall be secured to the runner channels and to structural supports at each crossing with tie wire, hairpin clips, or equivalent fastenings. Furring channels shall be located within 50 mm of parallel walls and beams, and shall be cut 13 mm short of abutting walls.

3.1.1.7 Ceiling Openings

Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 38 mm main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

3.1.1.8 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

3.2 ERECTION TOLERANCES

Framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;

b. Plates and runners: 5 mm in 1.9 meters from a straight line;

c. Studs: 5 mm in 1.9 meters out of plumb, not cumulative; and

d. Face of framing members: 5 mm in 1.9 meters from a true plane.

Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;

b. Plates and runners: 5 mm in 3.8 meters from a straight line;

c. Studs: 5 mm in 3.8 meters out of plumb, not cumulative; and

d. Face of framing members: 5 mm in 3.8 meters from a true plane.

-- End of Section --

SECTION 09250

GYPSUM BOARD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992) Interior Installation of Cementitious Backer Units
ANSI A118.9	(1992) Cementitious Backer Units

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 36/C 36M	(1999) Gypsum Wallboard
ASTM C 442/C 442M	(1999; Rev. A) Gypsum Backing Board and Coreboard
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 630/C 630M	(2001) Water-Resistant Gypsum Backing Board
ASTM C 840	(2001) Application and Finishing of Gypsum Board
ASTM C 954	(2000) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 1002	(2000) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases
ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1396/C 1396M	(2000) Standard Specification for Gypsum Board

ASTM D 226	(1997) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(2000) Application and Finishing of Gypsum Board

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2000) Fire Resistance Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Water Resistant Gypsum Backing Board; G, RE
Accessories; G, RE
Gypsum Wallboard; G, RE
Cementitious Backer Units; G, RE

Submit for each type of gypsum board and for cementitious backer units.

SD-07 Certificates

Asbestos Free Materials; G, RE

Certify that gypsum board types, cementitious backer units and joint treating materials do not contain asbestos.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct

exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 10 degrees C in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M.

2.1.1.1 Regular

1200 mm wide, thickness as shown tapered or beveled edges.

2.1.1.2 NOT USED

2.1.1.3 Type X (Special Fire-Resistant)

1200 mm wide, thickness as shown, tapered or beveled edges.

2.1.2 Gypsum Backing Board

ASTM C 442/C 442M, gypsum backing board shall be used as a base in a multilayer system.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C 630/C 630M

2.1.3.1 Regular

1200 mm wide, thickness as shown, tapered edges.

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 NOT USED

2.1.8 Cementitious Backer Units

ANSI A118.9.

2.1.9 Joint Treatment Materials

ASTM C 475.

2.1.9.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.9.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.9.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.9.4 NOT USED

2.1.9.5 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.10 Fasteners

2.1.10.1 Nails

ASTM C 514.

2.1.10.2 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.84 mm thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.84 to 2.84 mm thick. Provide cementitious backer unit screws with a polymer coating.

2.1.11 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.

2.1.11.1 Adhesive for Fastening Gypsum Board to Metal Framing

Type recommended by gypsum board manufacturer.

2.1.12 NOT USED

2.1.13 NOT USED

2.1.14 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment.

2.1.15 Asphalt Impregnated Building Felt

The moisture barrier over gypsum sheathing shall be 6.7 kg asphalt impregnated felt conforming to ASTM D 226 Type I (No. 15).

2.1.16 Water

Clean, fresh, and potable.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 NOT USED

3.2.2 NOT USED

3.2.3 NOT USED

3.2.4 NOT USED

3.2.5 NOT USED

3.2.6 NOT USED

3.2.7 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.2.8 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C 840, System IX or GA 216.

3.2.9 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas apply water-resistant gypsum backing board in accordance with ASTM C 840, System X or GA 216.

3.2.10 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C 840, System XI or GA 216.

3.2.11 NOT USED

3.2.12 NOT USED

3.2.13 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C 840, System XIII or GA 216, unless indicated

otherwise. Control joints between studs in fire-rated construction shall be filled with firesafing insulation to match the fire-rating of construction.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. A 7.6 kg asphalt impregnated, continuous felt paper membrane shall be placed behind cementitious backer units, between backer units and studs or base layer of gypsum board. Membrane shall be placed with a minimum 150 mm overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to Level 2 in accordance with GA 214. Walls and ceilings to receive a heavy-grade wall covering or have textured finish before painting shall be finished to Level 3 in accordance with GA 214. Walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings shall be finished to Level 4 in accordance with GA 214. Unless otherwise specified, all gypsum board walls, partitions and ceilings shall be finished to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07900a "Joint Sealing." Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall framing in accordance with the specifications contained in UL Fire Resist Dir for the Design Number(s) indicated on the drawings. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

3.8 SHAFT WALL FRAMING

The shaft wall system shall be installed in accordance with the system manufacturer's published instructions. Bucks, anchors, blocking and other items placed in or behind shaft wall framing shall be coordinated with electrical and mechanical work. Fireproofing materials which are damaged or removed during shaft wall construction shall be patched or replaced.

-- End of Section --

SECTION 09310A

CERAMIC TILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.5	(1992) Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A118.1	(1992) Dry-Set Portland Cement Mortar
ANSI A118.4	(1992) Latex-Portland Cement Mortar
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Test Methods and Specifications for Cementitious Backer Units
ANSI A137.1	(1988) Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM C 33	(1999ael) Concrete Aggregates
ASTM C 144	(1999) Aggregate for Masonry Mortar
ASTM C 150	(1999a) Portland Cement
ASTM C 206	(1984; R 1997) Finishing Hydrated Lime

ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 241	(1997) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 648	(1998) Breaking Strength of Ceramic Tile
ASTM C 1026	(1987; R 1996) Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1999) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	(1991) Design Manual IV Dimensional Stone

TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk	(1997) Handbook for Ceramic Tile Installation

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Tile; G, RE
Setting-Bed; G, RE
Mortar, Grout, and Adhesive; G, RE

Manufacturer's catalog data and preprinted installation and cleaning instructions.

SD-04 Samples

Tile; G, RE
Accessories; G, RE

Marble Thresholds; G, RE

Samples of sufficient size to show color range, pattern, type and joints.

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 10 degrees C and rising. Temperature shall be maintained above 10 degrees C while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

PART 2 PRODUCTS

2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 41 kg and 113 kg for floor tile in accordance with ASTM C 648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C 1026. Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373. Floor tile shall have a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Floor tile shall be Class IV-Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027for abrasion resistance as related to foot traffic.

2.1.1 Mosaic Tile (CT-F)

Ceramic mosaic tile and trim shall be unglazed with cushion edges

porcelain. Tile size shall be 50 x 50 mm. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.1.2 Quarry Tile (QT-1)

Quarry tile and trim shall be unglazed with abrasive surface. Tile shall be 600 x 600 mm. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 Glazed Wall Tile (CT-A, CT-B, CT-W1, CT-W2)

Glazed wall tile and trim shall be cushion edged with bright glaze. Tile shall be 114 X 114 mm. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.2 SETTING-BED

The setting-bed shall be composed of the following:

2.2.1 Aggregate for Concrete Fill

Aggregate shall conform to ASTM C 33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.

2.2.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Sand shall conform to ASTM C 144.

2.2.4 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

2.2.5 NOT USED

2.2.6 Reinforcing Wire Fabric

Wire fabric shall conform to ASTM A 185. Wire shall be either 50 x 50 mm mesh, 16/16 wire or 38 x 50 mm mesh, 16/13 wire.

2.3 WATER

Water shall be potable.

2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

2.4.1 Dry-Set Portland Cement Mortar

ANSI A118.1.

2.4.2 NOT USED

2.4.3 Latex-Portland Cement Mortar

ANSI A118.4.

2.4.4 Ceramic Tile Grout

ANSI A118.6; latex-portland cement grout.

2.4.5 NOT USED

2.4.6 NOT USED

2.4.7 NOT USED

2.4.8 Cementitious Backer Board

Cementitious backer units, for use as title substrate over wood sub-floors, shall be in accordance with ANSI A118.9. Cementitious backer units shall be 16 mm thick.

2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by MIA Design Manual. Marble shall have a fine sand-rubbed finish and shall be white in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Portland Cement Mortar	3 mm in 2.4 meters	3.0 mm in 3 meters
Latex portland cement mortar	3 mm in 2.4 meters	3.0 mm in 3 meters

3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring

membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA Hdbk, method W243 and W244.

3.3.1 Workable or Cured Mortar Bed

Tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. A 0.102 mm polyethylene membrane, metal lath, and scratch coat shall also be installed. Workable mortar bed, materials, and installation of tile shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B.

3.3.2 Portland Cement Mortar and Latex-Portland Cement Mortar

Portland cement mortar or latex-portland cement shall be used to install tile in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA Hdbk, method F111, F113. Shower receptors shall be installed in accordance with TCA Hdbk, method B415.

3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B. Joints between quarry tile shall be between 6.35 mm (1/4 inch) and 9.53 mm (3/8 inch) in width and shall be uniform in width.

3.4.2 Portland Cement Mortar and Latex-Portland Cement

Portland Cement Mortar or mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

3.4.3 NOT USED

3.4.4 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

3.4.5 Waterproofing

Shower pans are specified in Section 15400 PLUMBING, GENERAL PURPOSE. Waterproofing under concrete fill shall conform to the requirements of Section 07132 BITUMINOUS WATERPROOFING.

3.4.6 Concrete Fill

Concrete fill shall be composed by volume of 1 part portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mixed with water to as dry a consistency as practicable. The fill shall be spread, tamped, and screeded to a true plane, and pitched to drains or leveled as shown. Concrete fill shall be thoroughly damp cured before application of setting-bed material . Concrete fill shall be reinforced with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped not less than 50 mm. Laps shall be tied together with 1.3 mm (18 gauge) wire every 250 mm along the finished edges and every 150 mm along the cut ends and edges. The reinforcement shall be supported and secured in the centers of concrete fills. The mesh shall be continuous; except where expansion joints occur, mesh shall be cut and discontinued across such joints. Reinforced concrete fill shall be provided under the setting-bed where the distance between the under-floor surface and the finished tile floor surface is 50 mm or greater, and shall be of such thickness that the mortar setting-bed over the concrete fill shall be not less nor more than the thickness required in the specified TCA Hdbk methods.

3.5 NOT USED

3.6 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 6 mm in width and shall be grouted full as specified for ceramic tile.

3.7 NOT USED

3.8 EXPANSION JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07900 JOINT SEALING.

3.8.1 Walls

Expansion joints shall be provided at control joints in backing material. Wherever backing material changes, an expansion joint shall be installed to separate the different materials.

3.8.2 Floors

Expansion joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 7.2 to 10.8 m each way in large interior floor areas and 3.6 to 4.8 m each way in large exterior areas or areas exposed to direct sunlight or moisture. Expansion joints shall extend through setting-beds and fill.

3.9 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --

SECTION 09510A

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 1264	(1998) Standard Classification for Acoustical Ceiling Products

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, RE

Drawings showing suspension system, method of anchoring and

fastening, details, and reflected ceiling plan.

SD-03 Product Data

Acoustical Ceiling Systems; G, RE

Manufacturer's descriptive data, catalog cuts, and installation instructions. Submittals which do not provide adequate data for the product evaluation will be rejected.

SD-04 Samples

Acoustical Units; G, RE

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

SD-06 Test Reports

Ceiling Attenuation Class and Test; G, RE

Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified sound transmission requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resist Dir may be submitted in lieu of test reports.

SD-07 Certificates

Acoustical Units

Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

1.3 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to furnish I-P RLF, other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills, shall also be I-P products. The Contractor shall coordinate the whole ceiling system with other details, like the location of access panels and ceiling penetrations, etc., shown on the drawings. If I-P products are used, the Contractor shall be responsible for all associated labor and materials and for the final assembly and performance of the specified work and products. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Reclamation of mineral fiber acoustical ceiling panels to be removed from the job site shall be in accordance with paragraph RECLAMATION PROCEDURES.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 16 degrees C nor more than 29 degrees C and a relative humidity of not more than 70 percent shall be maintained before, during, and after installation of acoustical units.

1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 10 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

2.1.1 Units for Exposed-Grid System

Type: III non-asbestos mineral fiber with painted finish.

Minimum NRC: 0.75 in open offices; 0.60 in conference rooms and teleconferencing rooms and other rooms as designated; 0.50 in all other rooms and areas when tested on mounting No. E-400

Pattern: C.

Nominal size: 600 by 600 mm.

Edge detail: SLT.

Finish: Factory-applied standard finish.

Minimum LR coefficient: 0.84.

Minimum CAC: 39.

2.2 SUSPENSION SYSTEM

Suspension system shall be standard, and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than 23 mm. Inside and outside corner caps shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in TI 809-04 and ASTM E 580.

2.3 HANGERS

Hangers shall be galvanized steel wire. Hangers and attachment shall support a minimum 1330 N ultimate vertical load without failure of supporting material or attachment.

2.4 NOT USED

2.5 NOT USED

2.6 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

2.7 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as specified in Section 09915 COLOR SCHEDULE.

2.8 ACOUSTICAL SEALANT

Acoustical sealant shall conform to ASTM C 834, non-staining.

PART 3 EXECUTION

3.1 INSTALLATION

Acoustical work shall be provided complete with necessary fastenings,

clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Wall molding shall be secured not more than 75 mm from ends of each length and not more than 400 mm on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 5 kg per square m or if required for fire resistance rating.

3.2 CEILING ACCESS PANELS

Ceiling access panels shall be located directly under the items which require access.

3.3 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or

improperly installed shall be removed and new units provided as directed.

3.4 RECLAMATION PROCEDURES

Ceiling tile, designated for recycling by the Contracting Officer, shall be neatly stacked on 1220 by 1220 mm pallets not higher than 1220 mm. Panels shall be completely dry. Pallets shall then be shrink wrapped and symmetrically stacked on top of each other without falling over.

-- End of Section --

SECTION 09650A

RESILIENT FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2240	(199el) Rubber Property - Durometer Hardness
ASTM D 4078	(1992; R 1996) Water Emulsion Floor Polish
ASTM E 648	(1999) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 662	(1997) Specific Optical Density of Smoke Generated by Solid Materials
ASTM F 1066	(1999) Vinyl Composition Floor Tile
ASTM F 1303	(1999) Sheet Vinyl Floor Covering with Backing
ASTM F 1344	(1996) Rubber Floor Tile

1.2 FIRE RESISTANCE REQUIREMENTS

Flooring in corridors and exits shall have a minimum average critical radiant flux of 0.22 watts per square centimeter when tested in accordance with ASTM E 648. The smoke density rating shall be less than 450 when tested in accordance with ASTM E 662.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Resilient Flooring and Accessories; G, RE

Manufacturer's descriptive data and installation instructions including cleaning and maintenance instructions.

SD-04 Samples

Flooring; G, RE

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 60 x 100 mm.

SD-06 Test Reports

Moisture Test; G, RE

Copies of test reports showing that representative product samples of the flooring proposed for use have been tested by an independent testing laboratory within the past three years or when formulation change occurred and conforms to the requirements specified.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 21 degrees C for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 21 degrees C and below 38 degrees C for 2 days before application, during application and 2 days after application. A minimum temperature of 13 degrees C shall be maintained thereafter.

1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 10 tiles for each 1000 tiles and 1 m square meters for each 92 square meters of sheet flooring installed. Extra materials shall be from

the same lot as those installed. Extra base material composed of 6 m of each color shall be furnished.

PART 2 PRODUCTS

2.1 VINYL-COMPOSITION TILE TYPE VCT-1

Vinyl-composition tile shall conform to ASTM F 1066, Class 2,(through pattern tile), Composition 1, asbestos-free, and shall be 305 mm square and 3.2 mm thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern.

2.2 SHEET VINYL FLOORING TYPE HSV-1

Sheet vinyl flooring shall be composed of a homogeneous, vinyl composition. Flooring shall be not less than 18OO mm wide. Sheet vinyl flooring with backing shall conform to ASTM F 1303, Type II, Grade 1 (minimum wear layer thickness 1.27 mm and minimum overall thickness 2.03 mm.Sheet vinyl flooring without backing shall meet the overall thickness 2.03 mm, composition, flexibility, indentation, and the solvent resistance requirements of ASTM F 1303, Type II. The solid vinyl color and pattern shall extend through the total thickness of the material. High quality vinyl welding rods for heat welding of joints shall be provided.

2.3 NOT USED

2.4 RUBBER FLOORING TYPE RLT

2.4.1 Rubber Tile

Rubber tile shall conform to ASTM F 1344 Class 1 homogeneous construction, Type A (solid color) 610 mm square. Surface shall be raised round studs with chamfered edges. Stud profile shall be low. Overall thickness shall be 4.76 mm thick.

2.5 STAIR TREADS, RISERS, AND STRINGERS

Treads, risers, and stringers shall conform to composition rubber compounded from a mixture of synthetic rubber. Overall thickness at treads shall be not less than 3 mm. Durometer hardness shall be 90, plus or minus 5, when tested in accordance with ASTM D 2240. Design shall be either a one piece nosing/tread/riser or a two piece nosing/tread with a matching coved riser. Installation shall include stringer angles on both the wall and banister sides, and landing trim. Surface of treads shall be raised circle with abrasive non-slip inserts.

2.6 RESILIENT BASE

Base shall be manufacturers standard rubber, coved style. Base shall be 100 mm high and a minimum 3 mm thick. Preformed inside and outside corners shall be furnished.

2.7 NOT USED

2.8 NOT USED

2.9 TRANSITION STRIP

A rubber transition strip tapered to meet abutting material shall be provided.

2.10 ADHESIVE

Adhesive for flooring and wall base shall be as recommended by the flooring manufacturer.

2.11 POLISH

Polish shall conform to ASTM D 4078.

2.12 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section 07900 JOINT SEALING.

2.13 MANUFACTURER'S COLOR AND TEXTURE

Color and texture shall be in accordance with Section 09915 COLOR SCHEDULE.

2.14 STATIC DISSIPATIVE SOLID VINYL TILE: SD/SVT

Static dissipative vinyl tile shall conform to FS SS-T-312, Type III. Tile shall meet the test requirements of UL 779. Tile shall be 900 x 900 mm, with heat welded seams, 3 mm thick. Insert tiles shall be static dissipative tiles with lettering in contrasting color reading "Static Dissipative Floor, Do Not Wax." Chemically weld seams per manufacturer' recommendations.

2.14.1 Adhesive

Adhesive shall be static dissipative adhesive specifically recommended by the manufacturer of the flooring.

2.14.2 Accessories

Accessories shall be as recommended by the manufacturer of the flooring.

2.14.3 Electrical Ground Connection

Connection between the static dissipative floor system and the external grounding system shall be provided. Contact with the static dissipative floor system shall be with conductive grounding strip and shall have the greater of the following: a minimum contact area of 5806 square mm (9 square inches) or the dimensions recommended by the manufacturer. The grounding conductor shall be as recommended by the manufacturer of the flooring.

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government.

3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

3.3 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

3.4 INSTALLATION OF VINYL-COMPOSITION TILE AND SOLID VINYL TILE

Tile flooring shall be installed with adhesive in accordance with the manufacturer's installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.5 INSTALLATION OF SHEET VINYL FLOORING

Sheet vinyl flooring shall be installed with adhesive in accordance with the manufacturer's written installation instructions. Flooring shall be fitted to the room by hand cutting, straight scribing, or pattern scribing as necessary to suit job conditions. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Seams shall be cut by overlapping or underscribing as recommended by the manufacturer. Seams and edges of sheet vinyl flooring in room areas shown on the drawings shall be bonded or welded as recommended by the manufacturer.

3.6 INSTALLATION OF RUBBER FLOORING

Rubber flooring shall be installed with adhesive in accordance with the

manufacturer's written installation instructions. Lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge pieces shall be less than one-half the field size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edges shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.7 NOT USED

3.8 INSTALLATION OF RESILIENT BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk.

3.9 INSTALLATION OF TREADS AND RISERS

Stair treads and risers shall be installed with adhesive in accordance with the manufacturer's written installation instructions. Treads and risers shall cover the full width of the stairs. Stairs wider than manufacturer's standard lengths shall have equal length pieces butted together to cover the treads.

3.10 NOT USED

3.11 CLEANING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be cleaned to remove all surplus adhesive. After installation, flooring shall be washed with a cleaning solution, rinsed thoroughly with clear cold water, and, except for raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile, given two coats of polish in accordance with manufacturers written instructions. After each polish coat, floors shall be buffed to an even luster with an electric polishing machine. Raised pattern rubber flooring, rubber tile and sheet rubber flooring, rubber stair treads, and static control vinyl tile shall be cleaned and maintained as recommended by the manufacturer.

3.12 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled shall be removed and replaced.

-- End of Section --

SECTION 09680A

CARPET

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16	(1998) Test Method: Colorfastness to Light
AATCC 134	(1996) Test Method: Electrostatic Propensity of Carpets
AATCC 165	(1999) Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 418	(1993; R 1997) Pile Yarn Floor Covering Construction
ASTM D 3278	(1996el) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 5252	(1998a) Practice for the Operation of the Hexapod Tumble Drum Tester
ASTM D 5417	(1999) Practice for Operation of the Vettermann Drum Tester
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(1996) Commercial Carpet Installation Standard

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630	Standard for the Surface Flammability of Carpet and Rugs (FF 1-70)

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G, RE
Molding; G, RE

Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

SD-03 Product Data

Carpet; G, RE

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

Surface Preparation; G, RE
Installation; G, RE

Three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

Regulatory Requirements; G, RE

Three copies of report stating that carpet contains recycled materials and/or involvement in a recycling or reuse program. Report shall include percentage of recycled material.

SD-04 Samples

Carpet; G, RE
Molding; G, RE

a. Carpet: Two "Production Quality" samples 500 x 500 mm of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 300 mm long.

c. Special Treatment Materials: Two samples showing system and installation method.

SD-06 Test Reports

Moisture and Alkalinity Tests; G, RE

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet; G, RE

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

Regulatory Requirements; G, RE

Report stating that the carpet contains recycled materials and indicating the actual percentage of recycled material.

SD-10 Operation and Maintenance Data

Carpet; G, RE
Cleaning and Protection

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

1.3 INSTALLATION REQUIREMENTS

1.3.1 Experience

All work shall be done by installation firms specializing in commercial carpet installation. The firm shall be a member of the Floor Covering Installation Contractor's Association (FCICA) or certified by the Floor Covering Installation Board (FCIB).

1.3.2 Certificate

Submit certificate from the Contractor attesting that the installation supervisor has had a minimum of 5 years experience in this type of work and will provide qualified, experienced installers to perform work. Include a list of previous jobs giving name, location, dollar value, and date, setting forth supervisor's installation experience.

1.4 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet type bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Contractor shall procure carpet in accordance with 40 CFR 247. Where possible, product shall be purchased locally to reduce emissions of fossil fuels from transporting.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 16 degrees C for 2 days prior to installation.

1.6 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 16 degrees C for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 13 degrees C shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

1.8 EXTRA MATERIAL

Extra material from same dye lot consisting of full width continuous broadloom shall be provided for future maintenance. A minimum of 10 percent of total square meters of each carpet type, pattern, and color shall be provided.

PART 2 PRODUCTS

2.1 CARPET TYPE CPT-1

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance.

2.1.1 Physical Characteristics

Carpet shall comply with the following:

a. Recycle Efforts: Use of nylon fiber with recycled content 25 per cent (minimum).

b. Carpet Construction: Tufted.

c. Type: Broadloom 3.6 m minimum usable carpet width.

d. Pile Type: Multilevel loop.

e. Pile Fiber: Commercial 100% branded (federally registered trademark) nylon continuous filament.

f. Pile or Wire Height: Minimum 3.48 mm in accordance with ASTM D 418.

h. Gauge or Pitch: Minimum 1/2 (4.72 rows/cm) in accordance with ASTM D 418.

j. Finished Pile Yarn Weight: Minimum 1,017 g per square meter. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 418.

k. Pile Density: Minimum 7883.

l. Dye Method: Solution dyed.

m. Backing Materials: Primary backing materials shall be those customarily used and accepted by the trade for each type of carpet. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is provided.

2.1.2 Performance Requirements

a. ARR (Appearance Retention Rating): Carpet shall be tested and have the minimum 3.0-3.5 (Heavy) ARR when tested in accordance with either the ASTM D 5252 (Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.

b. Static Control: Static control shall be provided to permanently control static buildup to less than 3 kV when tested at 20 percent relative humidity and 21 degrees C in accordance with AATCC 134.

c. Flammability and Critical Radiant Flux Requirements: Carpet shall comply with 16 CFR 1630. Carpet in corridors and exits shall have a minimum average critical radiant flux of 0.22 watts per square centimeter when tested in accordance with ASTM E 648.

d. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 40 N average force for loop pile.

e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

f. Colorfastness to Light: Colorfastness to light shall comply with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.

g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 440 N/m .

2.2 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and nonstaining as recommended by the carpet manufacturer. Release adhesive for modular tile carpet shall be as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 60 degrees C in accordance with ASTM D 3278.

2.3 MOLDING

Vinyl molding shall be heavy-duty and designed for the type of carpet being installed. Floor flange shall be a minimum 50 mm wide. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.4 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

2.5 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

3.2 MOISTURE AND ALKALINITY TESTS

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

3.4 INSTALLATION

All work shall be performed by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding; installation shall be in accordance with the molding manufacturer's instructions.

3.4.1 Broadloom Installation

Broadloom carpet shall be installed direct glue down and shall be smooth, uniform, and secure, with a minimum of seams. Seams shall be uniform, unnoticeable, and treated with a seam adhesive. Side seams shall be run toward the light where practical and where such layout does not increase the number of seams. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched. Cutouts, as at door jambs, columns and ducts shall be neatly cut and fitted securely. Seams at doorways shall be located parallel to and centered directly under doors. Seams shall not be made perpendicular to doors or at pivot points. Seams at changes in directions of corridors shall follow the wall line parallel to the carpet direction. Corridors with widths less than 1.8 m shall have the carpet laid lengthwise down the corridors.

3.5 CLEANING AND PROTECTION

3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 600 mm in dimension with more than 0.6 square meters total, shall be provided. Non-retained scraps shall be removed from site and recycled appropriately.

-- End of Section --

SECTION 09697

WALK-OFF MAT

PART 1 GENERAL

1.1 REFERENCES (NOT APPLICABLE)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

Acceptable Manufacturer Products

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacture products are specifically mentioned in this specification:

Walk Off Mat

Bonar Floors Inc.

Tuftiguard Design, Module 2 Closed.

Manuf. Product submitted as an "or equal"; G, RE.

SD-04 Shop Drawings

Walk-Off Mat; G, RE

Submit detail drawings for approval, clearly indicating location of seams and method of installation. Manufacturer's literature shall be accepted as submittal to indicate installation materials to be used.

SD-14 Samples

Walk-Off Mat

Submit one sample of mat carpet tread in aluminum tread rails as indicated on drawings and of sufficient size to clearly show construction.

PART 2 PRODUCTS

2.1 CARPET TREADS

Furnish and install in size and quantity indicated on drawings. Provide walk-off mat in sections, as recommended by the manufacturer, to allow easy removal for cleaning trapped dirt from recess under mat. Seams shall run parallel to doors where possible. Walk-off mat shall have carpet treads of 100% Antron III nylon fiber unitary fusion bonded. Color shall be selected from manufacturers standard products, in accordance with Section 09915 COLOR SCHEDULE. Tread shall be securely locked into tread rails, yet remain easily accessible for in-field replacement.

2.2 MAT RAILS

Mat shall include aluminum tread rails fabricated of 6063-T52 aluminum alloy, and shall be continuously hinged at each tread connection to permit cleaning (independent vinyl hinges between tread rails shall not be acceptable). Tread rail finish shall be in accordance with Section 09915 COLOR SCHEDULE.

2.3 FRAME

Aluminum frame finish and vinyl fillers, as required, shall be furnished in in accordance with Section 09915 COLOR SCHEDULE. Fabricate frame in sections for easy removal from recess for cleaning. Sections shall be of number and size as recommended by manufacturer for ease of handling.

PART 3 EXECUTION

3.1 WORK ENVIRONMENT

All painting and finish work shall be complete. Ceilings and overhead work shall be tested, approved, and completed prior to installation of walk-off mat. Maintain room temperature at minimum 16 degrees C and relative humidity at the approximate level that will be maintained in the completed building for 24 hours prior to installation of recessed mat.

3.2 PREPARATION OF SURFACES

Clean floors of dust, dirt, solvents, oil, grease, paint, plaster, and other substances detrimental to proper performance of installation. Allow floors to thoroughly dry. Ensure floors are level, with maximum surface variation of 3.2 mm in 30 mm, noncumulative. Ensure concrete floors are free from scaling and irregularities and exhibit neutrality relative to acidity and alkalinity. Use an approved cementitious filler to patch cracks and small holes and for leveling.

3.3 INSTALLATION

Install aluminum frame in size and type indicated on drawings. Install walk-off mat in size, type, and locations as indicated on drawings. Install mat using manufacturer's standard installation method and

instructions.

-- End of Section --

SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values	(1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
ACGIH TLV-DOC	Documentation of Threshold Limit Values and Biological Exposure Indices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 523	(1999) Standard Test Method for Specular Gloss
ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(1998) Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants

FEDERAL STANDARDS (FED-STD)

FED-STD-313	(Rev. C) Material Safety Data, Transportation Data and Disposal Data for

Hazardous Materials Furnished to Government Activities

MASTER PAINTERS INSTITUTE (MPI)

MPI 4	(2001) Interior/Exterior Latex Block Filler
MPI 23	(2001) Surface Tolerant Metal Primer
MPI 27	(2001) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 42	(2001) Latex Stucco and Masonry Textured Coating
MPI 47	(2001) Interior Alkyd, Semi-Gloss
MPI 50	(2001) Interior Latex Primer Sealer
MPI 51	(2001) Interior Alkyd, Eggshell
MPI 52	(2001) Interior Latex, Gloss Level 3
MPI 54	(2001) Interior Latex, Semi-Gloss
MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 77	(2001) Epoxy Cold Cured, Gloss
MPI 79	(2001) Marine Alkyd Metal Primer
MPI 90	(2001) Interior Wood Stain, Semi-Transparent
MPI 94	(2001) Exterior Alkyd, Semi-Gloss
MPI 101	(2001) Cold Curing Epoxy Primer
MPI 107	(2001) Rust Inhibitive Primer (Water-Based)
MPI 108	(2001) High Build Epoxy Marine Coating
MPI 110	(2001) Interior/Exterior High Performance Acrylic
MPI 116	(2001) Epoxy Block Filler
MPI 134	(2001) Waterborne Galvanized Primer
MPI 140	(2001) High Performance Architectural Latex - Gloss Level 4
MPI 141	(2001) High Performance Semigloss Latex,

	White and Tints - Gloss Level 5
MPI 146	Institutional Low Odor/VOC Interior Latex - Gloss Level 4 (a 'satin-like' finish)
MPI 147	(2001) Institutional Low Odor / VOC Interior Latex, Gloss Level 5

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS-EPP-SP01-01	(2001) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC PA 3	(1995) Safety in Paint Application
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC VIS 3	(1993) Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning
SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating

1.2 SUBMITTALS

Select only one of the three submittal notes and its corresponding paragraph provided below. Delete this bracketed paragraph and the two submittal notes and paragraphs not applicable to this section.

Submit the following in accordance with Section 01330, "Submittal Procedures."

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS-EPP-SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification; G, RE

Submit color stencil codes; G, RE

SD-03 Product Data

Coating; G, RE

Manufacturer's Technical Data Sheets

SD-04 Samples

Color; G, RE

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications; G, RE

Qualification Testing laboratory for coatings G, RE

SD-08 Manufacturer's Instructions

Application instructions; G, RE

Mixing; G, RE

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings: G, RE

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one liter samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystilline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH Limit Values and ACGIH TLV-DOC confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 20 liters. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 4 to 35 degrees C.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Appendix A of EM-385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH Limit Values, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 3 degrees C above dew point;

b. Below 10 degrees C or over 35 degrees C, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be in accordance with Section 09915 COLOR SCHEDULE.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces of the buildings and appurtenances as indicated.

1.10.1.2 Interior Painting

Includes new surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

1.10.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm. Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals throughout the piping systems.

1.10.4 NOT USED

1.10.5 NOT USED

1.10.6 Definitions and Abbreviations

1.10.6.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.6.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.6.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.).

They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.6.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.6.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.6.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.6.7 EXT

MPI short term designation for an exterior coating system.

1.10.6.8 INT

MPI short term designation for an interior coating system.

1.10.6.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.6.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.6.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.6.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.6.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.6.14 Paint

See Coating definition.

1.10.6.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.6.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades

involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 NOT USED

3.3 NOT USED

3.4 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primmed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.5 PREPARATION OF METAL SURFACES

3.5.1 New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Water jetting to SSPC SP 12 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3.

3.5.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.5.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

3.5.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.5.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

3.5.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 0.20 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water.

3.6 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.6.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, and 6.4 liters of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new, surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 0.4 square meter of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

e. CMU Block Filler: Acrylic block filler, acrylic resin coating that fills voids in masonry block for use on interior and exterior rough surfaces. Apply by brush, roller or spray to fill all voids, cracks and irregularities to allow for finish coats.

3.6.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.7 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.7.1 NOT USED

3.7.2 NOT USED

3.7.3 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.8 APPLICATION

3.8.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 0.025 mm. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.

3.8.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 0.125 L of suitable thinner per liter. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.8.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.8.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the

respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
Division 9: Exterior Stucco Paint Table
Division 10. Exterior Cloth Coverings and Bituminous Coated Surfaces Paint Table

Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 0.038 mm each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

3.9 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 0.038 mm DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.10 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.11 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.12 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 13 mm high for piping and a minimum of 50 mm high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.13 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.14 PAINT TABLES

All DFT's are minimum values.

3.14.1 EXTERIOR PAINT TABLES

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Alkyd
New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 94	MPI 94

STEEL / FERROUS SURFACES
System DFT: 131 microns

B. New Steel that has been blast-cleaned to SSPC SP 6:

1. Alkyd
New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 94	MPI 94

System DFT: 131 microns

C. New steel blast cleaned to SSPC SP 10:

1. Waterborne Light Industrial
MPI EXT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 110-G5

System DFT: 212 microns

D. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Enamel
MPI EXT 5.1S-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 27	MPI 27 (+NSA)

System DFT:

EXTERIOR GALVANIZED SURFACES

E. New Galvanized surfaces:

1. Waterborne Primer / Waterborne Light Industrial Coating
MPI EXT 5.3J-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 110-G5	MPI 110-G5

System DFT: 112 microns

MPI EXT 5.3J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 110-G6	MPI 110-G6

System DFT: 112 microns

F. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating
MPI REX 5.3J-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 134	N/A	MPI 110-G5

System DFT: 112 microns

G. Galvanized surfaces with severely deteriorated coating or rusting:

EXTERIOR GALVANIZED SURFACES

1. Waterborne Light Industrial Coating
   MPI REX 5.3L-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 110-G5

   System DFT: 212 microns

3.14.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New Concrete, vertical surfaces, not specified otherwise:

1. High Performance Architectural Latex
   New; MPI INT 3.1C-G4 (satin) / Existing; MPI RIN 3.1J-G4

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 140	MPI 140

   System DFT: 100 microns

   New; MPI INT 3.1C-G5 (Semigloss) / Existing; MPI RIN 3.1J-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 141	MPI 141

   System DFT: 100 microns

   Fill all holes in masonry surface. Provide CMU block filler prior to painting.

B. Concrete ceilings, uncoated:

1. Latex Aggregate
   MPI INT 3.1N

Primer:	Intermediate:	Topcoat:
N/A	N/A	MPI 42

   System DFT: Per Manufacturer

   Texture - Medium. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions.
   Topcoat: Coating to match adjacent surfaces.

C. New , concrete floors as scheduled in drawings and recess area at floor mat:

1. Epoxy
   New; MPI INT 3.2C-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

   System DFT: 125 microns

   Note: Primer may be reduced for penetration per manufacturer's instructions.

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry:

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

1. High Performance Architectural Latex
   MPI INT 4.2D-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 140	MPI 140

   System DFT: 275 microns

   Fill all holes in masonry surface. Provide CMU block filler prior to painting.

2. Institutional Low Odor / Low VOC Latex
   New; MPI INT 4.2E-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 146	MPI 146

   System DFT: 100 microns

B. New Concrete masonry units in areas requiring a high degree of sanitation or high humidity areas, unless otherwise specified:

1. Waterborne Light Industrial Coating
   MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G3	MPI 110-G3

   System DFT: 275 microns

   Fill all holes in masonry surface. Provide CMU block filler prior to painting.

2. Epoxy
   MPI INT 4.2G-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 116	N/A	MPI 77	MPI 77

   System DFT: 250 microns

   Fill all holes in masonry surface. Provide CMU block filler prior to painting.

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports,Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. MPI INT 5.1E-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 51	MPI 51

   System DFT:

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New Wood Doors; Natural Finish or Stained:

1. Natural finish, oil-modified polyurethane
New; MPI INT 6.3K-G4 / Existing; MPI RIN 6.3K-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 100 microns

Note: Sand between all coats per manufacturers recommendations.

2. Stained, oil-modified polyurethane
New; MPI INT 6.3E-G4 / Existing; MPI RIN 6.3E-G4

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 57	MPI 57	MPI 57

System DFT: 100 microns

Note: Sand between all coats per manufacturers recommendations.

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New Wallboard not otherwise specified:

1. Latex
New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G2 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 100 microns

New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G3 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 100 microns

2. Institutional Low Odor / Low VOC Latex

New; MPI INT 9.2M-G4 (Satin) / Existing; MPI RIN 9.2M-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146

System DFT: 100 microns

New; MPI INT 9.2M-G5 (Semigloss) / Existing; MPI RIN 9.2M-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147

System DFT: 100 microns

B. New Plaster and Wallboard in toilets, food-preparation, restrooms, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified.:

1. Waterborne Light Industrial Coating
New; MPI INT 9.2L-G5 (Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

MPI 50	MPI 110-G5	MPI 110-G5

System DFT: 100 microns

2. Alkyd

New; MPI INT 9.2C-G5 (Semigloss) / Existing; MPI RIN 9.2C-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

System DFT: 100 microns

-- End of Section --

SECTION 09915R

COLOR SCHEDULE

PART 1 GENERAL

1.1 GENERAL

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color" as used herein includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, the Contractor shall propose a color for approval.

1.2 SUBMITTALS

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, the submittal shall be for Government Approval (G). Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following manufacturers are specifically mentioned in this specification: The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Contractor Color board

Manufacturer's Products Submitted as an "Equal"; G, RE.

4 sets of Contractor color boards, 90 days after the Contractor is given Notice to proceed, complying with the following requirements:

a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.

b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.

c. Samples shall be on 8-1/2 by 11 inch boards with a maximum spread

of 25-1/2 by 33 inches for foldouts.

f. Samples for the color board are required in addition to samples requested in other specification sections.

g. Color boards shall be submitted to the Contracting Officer.

PART 2 PRODUCTS

2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers.

2.1.1 Finish Vendors

Brick:
Interstate Brick
Corporate Headquarters
9780 South 5200 West
West Jordan, UT 84044-5625
Phone: 800-280-5220
www.interstatebrick.com

Mortar:
Brixment
Essroc
3251 Bath Pike
Nazareth, PA 18064
Phone: 800-523-9238
www.essroc.com

Interior/Exterior Paint:
ICI/Dulux Paints
www.iciduluxpaints.com

Concrete Masonry Unit:
E. Dillon & Company
P.O. Box 160
Swords Creek, VA 24649
Phone: 800-234-8970
www.edillon.com

Precast Concrete:
Gate Precast Company
14 Interchange Drive
Savannah, GA 31415
Phone: 912-236-8457
www.gateprecast.com

Spandrel Glass/Curtain Wall, Glass & Glazing:
Pilkington Eclipse

811 Madison Avenue
P.O. Box 799
Toledo, OH 43695
419-247-3731
www.pilkington.com

Window Frames & Storefront:
Kawneer
555 Guthridge Ct.
Technology Park/Atlanta
Norcross, GA 30092
Phone: 877-767-9107
www.kawneer.com

Gutters and Downspouts,
Overhangs, Fascia,
Mechanical Louvers
Metal Roofing Panels:
Centria Architectural Systems
1005 Beaver Grade Road
Moon Township, PA 15108-2944
Phone: 800-759-7474
www.centria.com

Acoustical Ceiling Tile:
USG Interiors, Inc.
125 South Frankling Street
P.O. Box 4470
Chicago, IL 60680-4470
Phone: 800-950-3839
www.usg.com

Concrete Sealer:
Prosoco
3741 Greenway Circle
Lawrence, KS 66046
Phone: 800-255-4255
www.prosoco.com

Carpet:
J & J Commercial Carpets
Doug Bowman
Phone: 800-241-4586, ext. 7983
www.jjcommercial.com

Ceramic Tile and Quarry Tile:
Daltile Corporation
7834 C. F. Hawn Freeway
Dallas, TX 75217
Phone: 214-398-1411
www.daltile.com

Glazed Concrete Masonry Unit:
Trenwyth Industries

One Connelly Road
P.O. Box 438
Emigsville, PA 17318
Phone: 800-233-1924
www.trenwyth.com

Quartz Tile:
Cambria
Louisville Tile Distributors Inc.
4520 Bishop Lane
Louisville, KY 40218
Phone: 800-678-8453
www.louisville-tile.com

Rubber Base, Stair Treads, Landing Tiles:
Johnsonite
16910 Munn Road
Chagrin Falls, OH 44023
Phone: 800-899-8916
www.johnsonite.com

Recessed Entry Mat:
Tuftiguard
Bonar Floor Inc.
365 Walt Sanders Memorial Drive
Suite 100
Newnan, GA
Phone: 800-852-8292
www.bonarfloors.com

Static Dissipative/Solid Vinyl Tile:
Flexco
East 6th Street
P.O. Box 553
Tuscumbia, AL 35674
Phone: 256-383-7474
www.marleyflexco.com

Vinyl Composition Tile,
Homogenous Sheet Vinyl
Mannington
Mannington Mills Road
Salem, NJ 08079
Phone: 609-935-3000
www.mannington.com

Wood Stain:
Sherwin Williams
101 Prospect Avenue
10 Midland Building
Cleveland, OH 44115
Phone: 216-566-2000
www.sherwinwilliams.com

Vertical Blinds:
Graber
Springs Industrial Inc.
P.O. Box 70
Fort Mills, SC 29716
Phone: 800-544-4749
www.springs.com

Horizontal Blinds:
Bali
Springs Industrial Inc.
P.O. Box 70
Fort Mills, SC 29716
Phone: 800-544-4749
www.springs.com

Laminate:
Nevamar
1200 Highland Drive
West Hampton, NJ 08060
Phone: 609-702-5940
www.nevamar.com

Solid Surface:
Wilsonart International
2400 Wilson Place
P.O. Box 6110
Temple, TX 76503-6110
Phone: 800-433-3222
www.wilsonart.com

Grout:
Mapei Corporation
1501 Wall Street
Garland, TX 75041
Phone: 972-271-9500
www.mapei.com

Corner Guards:
C/S Acrovyn
7620-J Rickenbacker Drive
Gaithersburg, MD 20879
Phone: 301-869-6675

Toilet and Urinal Screens:
Capital Toilet Partitions
9199 Red Branch Road
Columbia, MD 21045
Phone: 410-740-8870
www.capitalpartitions.com

Lockers and Locker Room Benches
Penco Products Inc.
99 Brower Avenue

P.O. Box 378
Oaks, PA 19456-0378
Phone: 800-562-1000
www.pencoproducts.com

Medical Wing Casework:
Midmark Corporation
60 Vista Drive
P.O. Box 286
Versailles, OH 45380-0286
(800-Midmark)

Lyon Metal Products
P.O. Box 671
Aurora, IL 60507-0671
Tele: 630-392-8941 / 800-323-0082
Fax: 800-367-6681
www.lyon-metal.com-

Draper Inc.
11 S. Pearl St.
Spiceland, IN 47385
Tele: 800-238-7999
Fax: 765-987-7142

Claridge Products and Equipment
601 Highway 62-65 South
P.O. Box 910
Tele: 870-743-2200
Fax: 870-743-1908
Email: Claridge@Claridge Products. com

2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors.

2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

a. Brick:

BRK-1: Interstate Brick, Smokey Mountain-Matte, (800) 280-5220
BRK-2: Interstate Brick, Tumbleweed-Matte, (800) 280-5220

b. Mortar:

Brixment, E-131 Light Chocolate (Essroc 800 523-9238)

c. Paint:

PNT-5: ICI/Duluxpaints, 401 Oxford Inn

d. Concrete Masonry Units (Integrally Colored):

CMU-1: E. Dillon & Company, Arroyo, Smooth Face, (800 234-8970)

g. Precast Concrete: GatePrecast, Beige PP-56 (912-236-8457)

h. Glass and Glazing: Pilkington Eclipse, Blue-green Reflective Glass (419-247-3731)

i. Metal Wall Panels: Centria, 142 Surrey Beige (800-759-7474)

2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

a. Aluminum Doors and Frames: Kawneer, Classic Bronze.

b. Doors and Door Frames: PNT-5: ICI/Duluxpaints, 401 Oxford Inn

c. Overhead Coiling Doors: PNT-5: ICI/Duluxpaints, 401 Oxford Inn

d. Windows, including Aluminum Components of glazed Curtain Walls, (mullion, muntin, sash, trim, and sill): Kawneer, Classic Bronze (877-767-9107)

e. Fascia: Centria, 1243 Mocha (800-759-7474)

f. Downspouts, Gutter, Louvers, Collector Heads, and Flashings: Centria, 1243 Mocha (800-759-7474)

g. Soffits and Ceilings: PNT-4: ICI/Duluxpaints, 2015 White Whisper.

h. Signage: Refer to Spec Section 10430.

i. Overhangs: Centria, 1243 Mocha (800 759-7474)

j. Caulking and Sealants: Match to PNT-5.

2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Roof color shall be provided to match the colors listed below.

a. Metal: Centria, 1243 Mocha (800 759-7474)

2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below.

a. Carpet: CPT-1: J & J Commercial Carpet, 3945 Singing the Blues (800 241-4586, ext. 7983)

c. Vinyl Composition Tile: VCT-1: Mannington, Brushwork 717 Venetian Silk (609-935-3000)

d. Sheet Vinyl: HSV-1: Mannington, GLS Series, Frost 13602 Frosted Silk (609 935-3000)

e. Raised Pattern Rubber Tile: RLT: Johnsonite, RH-45 Sandalwood, Round Pattern (800 899-8916)

f. Stair Treads, Kick Strips, and Risers: RST: Johnsonite VIRH-45, Sandalwood, Round Pattern (800 899-8916)

g. Quarry Tile: QT-1: Daltile, OT05 Adobe Brown (214 398-1411)

h. Ceramic Tile: CT-F: Daltile, DK-50 Mottled Medium Brown (214 398-1411).

j. Grout:

Ceramic Grout: Mapei, 15 Bone (972 271-9500)
Quartz Tile Grout: Mapei, 05 Chamois (972 271-9500)

m. Static Dissipative Tile: SD/SVT: Flexco, ESD-43 Ivory Buckskin (256 383-7474)

n. Concrete: CONC-1: Prosco, clear impregnator (800-255-4255).

o. Quartz Tile:

QFT-1: Cambria, Stafford Brown C-112 (800 678-8453)
QFT-1: Cambria, Bristol Blue C-321 (800 678-8453)

2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

a. Resilient Base and Edge Strips: RB: Johnsonite, 45 Sandalwood (800 899-8916)

c. Ceramic Tile: CT-B; Daltile, K-174 Mexican Sand (214 398-1411)

e. Grout:

Ceramic Grout: Mapei, 15 Bone (972 271-9500)
Quartz Tile Grout: Mapei, 05 Chamois (972 271-9500)

g. Glazed Structural Units:

CGMU-1: Trenwyth, SW Safari Beige (972 233-1924)

l. Quartz Tile: QTF-B: Cambria, Stafford Brown C-112 (800 678-8453).

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Wall materials shall be provided to match the colors listed below.

a. Paint:

PNT-1: ICI/DULUX, 2002 Bone White.
PNT-2: ICI/DULUX, 479 Dapper Tan.
PNT-3: ICI/DULUX, 420 Tantalizing Tan.
PNT-4: ICI/DULUX, 2015 White Whisper.

b. Ceramic Tile:

CT-A: Daltile, K-189 Navy (214 398-1411).
CT-W1: Daltile, 0135 Almond (214 398-1411).
CT-W2: Daltile, K-174 Mexican Sand (214 398-1411).

e. Ceramic Tile Grout: Mapei, 15 Bone (972 271-9500).

i. Glazed Structural Units:

GCMU-1: Trenwyth, SW Safari Beige (800 233-1924)
GCMU-2: Trenwyth, SW Cosmic Blue (800 233-1924)

2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Ceiling materials shall be provided to match the colors listed below.

a. Acoustical Tile and Grid:

ACT: USG, Radar, Climaplus, White (800 950-3839)
Grid: USG, Donn DX, White (800 950-3839)

b. Paint: PNT-4: ICI/DULUX, 2015 White Whisper.

c. Structural Framing: PNT-4: ICI/DULUX, 2015 White Whisper.

d. Metal Deck: PNT-4: ICI/DULUX, 2015 White Whisper.

2.2.8 Interior Trim

Interior trim shall be provided to match the colors listed below.

a. Doors: STN-1: Sherwin Williams, SW 3114-K Warm Chestnut (216 566-2000)

b. Door Frames: PNT-3: ICI/DULUX, 420 Tantilizing Tan.

c. Chair Rail: PNT-3: ICI/DULUX, 420 Tantilizing Tan.

d. Windows (mullion, muntin, sash, and trim): Kawneer, Classic Bronze (905 673-5400).

e. Window Stool: SSM-1: Wilsonart, Antique White, 1572 SL (800 433-3222)

f. Fire Extinguisher Cabinets: Red (Factory Applied Finish)

g. Handrails: PNT-3: ICI/DULUX, 420 Tantilizing Tan.

h. Wood Stain: STN-1: Sherwin Williams, SW 3114-K Warm Chestnut (216 566-2000)

2.2.9 Interior Window Treatment

Window treatments shall be provided to match the colors listed below.

a. Horizontal Blinds: Bali, 112 Alabaster (800 544-4749)

b. Vertical Blinds: Graber, Crown, Ivory 9307 (800 544-4749)

2.2.10 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

a. Toilet Partitions and Urinal Screen: LAM-3: Capital Toilet Partitions, Navy Matrix MR-3-5T (410 740-8870)

b. Plastic Laminate:

LAM-1: Nevamar, Dreamy Allusion AL-3-2T (609 702-5940)
LAM-2: Nevamar, Carmelite Metal X MXN-005T (609 702-5940)
LAM-3: Nevamar, Navy Matrix MR-3-5T (609 702-5940)

c. Signage Message Color (excluding handicapped signage): White.

d. Signage Background Color (excluding handicapped signage): Black.

e. Lockers: Penco, 073 Champagne (800-562-1000).

g. Corner Guards: C/S Acrovyn, FS-10/20R, 866 Doeskin (301-869-6675).

h. Bumperguard: C/S Acrovyn, BCR-40, 866 Doeskin.

i. Wall Switch Handles and Standard Receptacle Bodies: Ivory.

j. Electrical Device Cover Plates and Panels: Ivory.

k. Casework:

Breakroom Counters LAM-1: Nevamar, Dreamy Allusion AL-3-2T.
Breakroom Base Cabinets LAM-2: Nevamar, Carmelite MetalX MXN-005T.
Vanity Base/Skirt LAM-3: Nevamar, Navy Matrix MR-3-5T.
Vanity Top SSM-1: Wilsonart, Antique White 1572-SL.
Recessed Access Panel SSV-1: Wilsonart, Antique White 1572-SL.
Recessed Entry Mat: Tuftigard/Nuway-Charcoal Wiperstrip/Charcoal Scraper Bar (800-852-8292).
Mail Room Counter LAM-1: Nevamar, Dreamy Allusion AL-3-2T.
Mail Room Support Panels LAM-2: Nevamar, Carmelite Metalx MXN-005T.
Mail Room Shelves LAM-2: Nevamar, Carmelite Metalx MXN-005T.
Medical Wing Counters LAM-1: Nevamar/Midmark, Dreamy Allusion AL-3-2T (800-MIDMARK).
Medical Wing Base Cabinets: Midmark Casework, Pearl Grey Base and Kick Plate (800-MIDMARK).

2.2.11 Specialty items shall be provided to match the colors listed below.

a.	Markerboards:	Claridge Products	Series 3, Type A, White writing surface Clear anododized alunimum frames
b.	Map Rails:	Claridge Products	No. 74 w/No. 76 Hooks Clear anododized alunimum frames
c.	Tackboards:	Claridge Products	Series 3, Type CO, 112 Desert Sand Clear anododized alunimum frames
d.	Projection:	Draper Incorporated Screens	Envoy Electric Screen Series Black Border with White Screen
e.	Metal Storage:	Lyon Metal Prod. Shelving (10552R)	Putty Finish
f.	Wire Mesh:	Lyon Metal Prod. Partitions (10605N)	Putty Finish

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 10100A

VISUAL COMMUNICATIONS SPECIALTIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM F 152	(1995) Tension Testing of Nonmetallic Gasket Materials

1.2 GENERAL REQUIREMENTS

The term visual display board when used herein includes presentation boards, marker boards, tackboards, board cases, display track system and horizontal sliding units. Visual display boards shall be from manufacturer's standard product line.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Visual Display Boards

Manufacturer's descriptive data and catalog cuts. Manufacturer's installation instructions, and cleaning and maintenance instructions.

SD-04 Samples

Aluminum; G, RE

Sections of frame, map rail, and chalktray, and two map hooks.

Porcelain Enamel; G, RE

Section showing porcelain enamel coating, steel, core material and backing.

Materials; G, RE

Section of core material showing the lamination of colored cork, natural cork, woven fabric, non-woven fabric, and vinyl wall covering. Sample of hardwood and plastic laminate finish, and glass type. Samples shall be minimum 100 by 100 mm and show range of color.

SD-07 Certificates

Visual Display Boards

Certificate of compliance signed by Contractor attesting that visual display boards conform to the requirements specified.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to the building site in the manufacturer's original unopened containers and shall be stored in a clean dry area with temperature maintained above10 degrees C . Materials shall be stacked according to manufacturer's recommendations. Visual display boards shall be allowed to acclimate to the building temperature for 24 hours prior to installation.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 COLOR

Finish colors for required items shall be as specified in Section 09915 COLOR SCHEDULE.

2.2 MATERIALS

2.2.1 Porcelain Enamel

Marker board writing surface shall be composed of porcelain enamel fused to a nominal 0.378 mm (28 gauge) thick steel, laminated to a minimum 6 mm thick core material with a steel or foil backing sheet. Writing surface shall be capable of supporting paper by means of magnets. Marker board surface for display track system may be a powder paint dry erase surface adhered to a nominal 1.214 mm (18 gauge) thick steel.

2.2.2 Cork

Cork shall be a continuous resilient sheet made from soft, clean, granulated cork relatively free from hardback and dust and bonded with a binder suitable for the purpose intended. The wearing surface shall be free from streaks, spots, cracks or other imperfections that would impair its usefulness or appearance. The material shall be seasoned, and a clean cut made not less than 13 mm from the edge shall show no evidence of soft sticky binder.

2.2.2.1 NOT USED

2.2.2.2 Natural Cork

Material shall be a single layer of pure grain natural cork without backing or facing. The color shall be light tan. The cork sheet shall have a tensile strength of not less than 275 kPa when tested in accordance with ASTM F 152.

2.2.3 NOT USED

2.2.4 NOT USED

2.2.5 NOT USED

2.2.6 Aluminum

Aluminum frame extrusions shall be alloy 6063-T5 or 6063-T6, conform to ASTM B 221M , and be a minimum 1.5 mm thick. Exposed aluminum shall have an anodized, satin finish. Straight, single lengths shall be used wherever possible. Joints shall be kept to a minimum. Corners shall be mitered and shall have a hairline closure.

2.3 NOT USED

2.4 MARKERBOARD

Markerboard shall have a porcelain enamel writing surface and a chalktray. Markerboard shall be a factory assembled unit complete in one piece, without joints whenever possible. When markerboard dimensions require delivery in separate sections, components shall be prefit at the factory, disassembled for delivery and jointed at the site. Frame shall be aluminum. Chalktray shall be the same material as the frame and extend the full length of the liquid markerboard. Dry erase markings shall be removable with a felt eraser or dry cloth without ghosting. Each unit shall come complete with an eraser and four different color compatible dry erase markers. The size shall be as shown in the drawings.

2.5 TACKBOARDS

2.5.1 Cork

Tackboard shall consist of a minimum 3 mm thick colored cork with burlap backing laminated to a minimum 10 mm thick insulation board or fiber board, and shall have an aluminum frame. The size shall be as shown in the drawings.

2.6 NOT USED

2.7 DISPLAY TRACK SYSTEM (MAP RAIL)

This method of display shall be a flexible and interchangeable system that consists of lightweight presentation components suspended from a wall mounted, linear, 50 mm horizontal track. Track shall have one levels to attach components. Track shall allow attached components to slide horizontally. Presentation components shall be capable of being lifted from the track and being relocated to allow for reconfiguration. Components shall be capable of being installed on the track without the use of tools for installation, removal, and reconfiguration. The presentation components shall consist of holders for displaying maps, presentation boards, drawings and other paper display materials up to a 3 mm thickness. Components shall be installed and located on track in accordance with manufacturer recommendations. The sizes shall be as shown in the drawings. Track and trim materials shall be as standardly produced by the manufacturer.

2.8 NOT USED

2.9 NOT USED

2.10 PROJECTION SCREEN

Recessed mount motorized projection screen shall have 120V motor that is lubricated for life, quick reversal type, has overload protector, integral gears, and preset accessible limit switches. Recessed mount projection screens shall have an operable closure door and access panel. Screen shall be flame retardant, mildew resistant, and white matte with black masking borders. Bottom of screen fabric shall be weighted with metal rod. Roller shall be a rigid metal at least 75 mm in diameter mounted on sound absorbing supports. Motor will be motor-in-roller design. Screen shall have a 3 position control switch to stop or reverse screen at any point. The switch shall be installed in a flush electrical box with cover plate, location(s) as shown on the electrical drawings. All conduit and wiring from the control switch to the projection screen shall be furnished and installed by the Contractor. Ceiling recessed case shall be extruded aluminum. Screen shall be UL listed. The size shall be as shown in the drawings.

PART 3 EXECUTION

3.1 PLACEMENT SCHEDULE

Location and mounting height of visual display boards, map rails, and tackboards shall be as shown on the drawings.

Mounting height is defined as distance from finished floor to top of the display board frame.

3.2 INSTALLATION

Installation and assembly shall be in accordance with manufacturer's printed instructions. Concealed fasteners shall be used. Visual display boards shall be attached to the walls with suitable devices to anchor each unit. The Contractor shall furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds, clips, backing materials, adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Installation shall not be initiated until completion of room painting and finishing operations. Visual display boards shall be installed in locations and at mounting heights indicated. Visual display boards shall be installed level and plumb, and if applicable doors shall be aligned and hardware shall be adjusted. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

3.3 CLEANING

Writing surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

SECTION 10106R

RECESSED DISPLAY CASES

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Display Case; G, RE

Indicate wall elevations, dimensions, and joint locations.

SD-03 Product Data

Display Cases, See Section 09915 COLOR SCHEDULE

Display Case Manuf. Product submitted as an "or equal"

Provide product literature on recessed display cases.

1.2 FIELD MEASUREMENTS

Verify that field measurements are as indicated on shop drawings.

1.3 WARRANTY

Include coverage of fabric surface from discoloration due to fading.

1.4 DELIVERY, STORAGE AND PROTECTION

Transport, handle, store and protect products. Protect finishes on case from other Work.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Plywood:

APA Structural I, Grade C-D birch species with aluminum front and trim: Conform to ASTM B209 with a walnut grain finish.

2.1.2 Components

Operable pair of glass doors with dual action, hinge, structural steel C channel, adjustable alignment pins, and concealed locks. Locks to be single key to operate both locks.

2.2 ACCESSORIES

2.2.1 Adhesives:

Type used by manufacturer.

2.2.2 Cleaning Instruction Plate:

Provide instructions for cleaning on a metal plate fastened to inside face of aluminum frame.

2.3 FABRICATION - RECESSED DISPLAY CASES

2.3.1 Recessed case

No. 394WB with aluminum front with satin anodized finish and a designer fabric back panel. Both units shall have 4.76 mm tempered glass sliding doors with finger pulls, locks and keys, shelf brackets, shelf standard and three 300mm wide adjustable 4.76mm tempered glass shelves.

2.3.2 Required items:

Wood box of 469mm in depth. Exposed wood shall be stained light oak.

2.3.3 Glass:

All glass shall be tempered.

2.3.4 Back Panel:

For fabric color see special item schedule.

2.3.5 Trim

Trim shall be satin anodized aluminum in accordance with COLOR SCHEDULE 09915.

2.4 FINISH

The recessed display case trim, shelves and fabric/ color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that internal wall blocking is ready to receive display case and

positioning dimensions are as indicated on shop drawings.

3.2 INSTALLATION

Install recessed display case, in accordance with manufacturer's instructions.

Establish bottom of perimeter frame above finished floor by indications on drawings.

Secure units level and plumb.

3.3 CLEANING

Clean recessed display case exposed surfaces in accordance with manufacturer's instructions.

---End of Section---

-- End of Section --

SECTION 10160A

TOILET PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003 (Basic) Partitions, Toilet, Complete

1.2 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, room entrance screens, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The partition system shall be provided by a single manufacturer, and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Toilet Partition System; G, RE.

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-03 Product Data

Toilet Partition System; G, RE.

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

SD-04 Samples

Toilet Partition System; G, RE.

Manufacturer's standard color charts and color samples.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style A, floor supported. Width, length, and height of toilet enclosures shall be as shown. Finish surface of panels shall be solid plastic. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800A TOILET ACCESSORIES, shall be prepared for mounting of the items required. Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 1112 N . Grab bars shall not rotate within their fittings.

2.2 NOT USED

2.3 URINAL SCREENS

Urinal screens shall conform to CID A-A-60003, Type III, wall mounted. Finish surface of screens shall be solid plastic. Width and height of urinal screens shall be as shown.

2.4 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids.

2.5 COLORS

Color of finishes for toilet partition system components shall be manufacturer's standard as specified in Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated,

anchorage to walls shall be by toggle-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work.

3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 5 mm and shall rest open at approximately 30 degrees when unlatched. Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

-- End of Section --

SECTION 10201N

METAL WALL LOUVERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500-L	(1991) Louvers, Dampers and Shutters
AMCA 511	(1991) Certified Ratings Program for Air Control Devices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Wall louvers; G, RE

Show all information necessary for fabrication and installation of louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

SD-04 Samples

Wall louvers; G, RE

Colors of finishes shall closely approximate colors indicated in accordance with Section 09915, COLOR SCHEDULE. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches,

and blemishes. Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 NOT USED

2.1.2 NOT USED

2.1.3 Extruded Aluminum

ASTM B 221M, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 1.44 kilopascals. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511. The rating shall show a water penetration of 0.06 kilograms or less per square meter of free area at a free velocity of 244 meters per minute and a 99.3% effectiveness rating at 46.4 kph (29 mph). Refer to Louver Schedule on Mechanical Drawings.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 2 mm.

2.2.2 NOT USED

2.2.3 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions for all louvers more than 1500 mm in width at not more than 1500 mm on centers. Provide mullions covers on both faces of joints between louvers.

2.2.4 Screens and Frames

For aluminum louvers, provide 12.5 mm square mesh, bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 NOT USED

2.4 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.5 FINISHES

2.5.1 Aluminum

Provide factory-applied finish.

2.5.2 High-Performance Coating

Exposed surfaces of aluminum louvers shall be finished with a Class 1 anodized finish consisting of a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 605, with a primer coat of 0.005 to 0.008 mm (0.20 to 0.030 mils) and a color coat of minimum 0.025 mm (1.0 mils), total dry film thickness of 0.030 to 0.033 mm (1.2 to 1.3 mils). Provide clear topcoat of .25 mm (.9 mils). Finish shall be free of scratches and other blemishes.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 NOT USED

3.1.3 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 NOT USED

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

-- End of Section --

SECTION 10260

WALL AND CORNER GUARDS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by thebasic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 221	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D 256	(2000e1) Determining the IZOD Pendulum Impact Resistance of Plastics
ASTM D 543	(1995; R 2001) Evaluating the Resistence of Plastics to Chemical Reagents
ASTM D 635	(1998) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM G 21	(1996) Determining Resistence of Synthetic Polymeric Materials to Fungi
ASTM G 22	(1976; R 1996) Determining Resistance of Plastics to Bacteria

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J 1545	(1986) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as

otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Corner Guards; G, RE
Wall Guards (Bumper Guards); G, RE

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details.

SD-03 Product Data

Corner Guards; G, RE
Wall Guards (Bumper Guards); G, RE

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

SD-04 Samples

Finish; G, RE

Manufacturer's standard samples indicating color and texture of materials requiring color and finish selection.

SD-06 Test Reports

Corner Guards; G, RE
Wall Guards (Bumper Guards); G, RE

Fire rating and extinguishing test results for resilient material.

SD-07 Certificates

Corner Guards; FIO
Wall Guards (Bumper Guards); FIO

Statements attesting that the items comply with specified fire and safety code requirements.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Materials shall be kept dry, protected from weather and damage, and stored under cover. Materials shall be stored at approximately 21 degrees C for at least 48 hours prior to installation.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 GENERAL

To the maximum extent possible, corner guards, door and door frame protectors, wall guards (bumper guards), shall be the standard products of a single manufacturer and shall be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

2.1.1 Resilient Material

Resilient material shall consist of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic and shall conform to the following:

2.1.1.1 Minimum Impact Resistance

Minimum impact resistance shall be 960.8 N.m/m (18 ft. lb/sq. inch) when tested in accordance with ASTM D 256, (Izod impact, ft. lbs per sq inch notched).

2.1.1.2 Fire Rating

Fire rating shall be Class 1 when tested in accordance with ASTM E 84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material shall be rated self extinguishing when tested in accordance with ASTM D 635. Material shall be labeled and tested by an approved nationally known testing laboratory. Resilient material used for protection on fire rated doors and frames shall be listed by the testing laboratory performing the tests. Resilient material installed on fire rated wood/steel door and frame assemblies shall have been tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly will not be acceptable.

2.1.1.3 Integral Color

Colored components shall have integral color and shall be matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.1.1.4 Chemical and Stain Resistance

Materials shall be resistant to chemicals and stains reagents in accordance with ASTM D 543.

2.1.1.5 Fungal and Bacterial Resistance

Materials shall be resistant to fungi and bacteria in accordance with ASTM

G 21 or ASTM G 22, as applicable.

2.2 CORNER GUARDS

2.2.1 Resilient Corner Guards

Corner guard units shall be flush mounted type, radius formed to profile shown. Corner guards shall extend from floor to ceiling. Mounting hardware, cushions, and base plates shall be furnished. Assembly shall consist of a snap-on corner guard formed from high impact resistant resilient material, minimum 1.98 mm thick, mounted on a continuous aluminum retainer. Extruded aluminum retainer shall conform to ASTM B 221, alloy 6063, temper T5 or T6. Flush mounted type guards shall act as a stop for adjacent wall finish material. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards. Flush mounted corner guards installed in fire rated wall shall maintain the rating of the wall. Insulating materials that are an integral part of the corner guard system shall be provided by the manufacturer of the corner guard system. Exposed metal portions of fire rated assemblies shall have a paintable surface.

2.2.2 Stainless Steel Corner Guards

Stainless steel corner guards shall be fabricated of 1.58 mm thick material conforming to ASTM A 167, type 302 or 304. Corner guards shall extend from floor to ceiling. Corner guard shall be formed to dimensions shown.

2.3 WALL GUARDS (BUMPER GUARDS)

2.3.1 NOT USED

2.3.1.1 Wall Guards

Wall guards shall consist of snap-on covers of high impact resistant resilient material, minimum 1.98 mm thick, mounted over on a continuous, extruded aluminum retainer, minimum 1.83 mm thick, anchored to wall at maximum 600 mm on center.

2.4 NOT USED

2.5 NOT USED

2.6 TRIM, FASTENERS AND ANCHORS

Vinyl trim, fasteners and anchors shall be provided for each specific installation as shown.

2.7 FINISH

2.7.1 NOT USED

2.7.2 Stainless Steel Finish

Finish for stainless steel shall be in accordance with ASTM A 167, Type 302 or 304, finish number 4.

2.7.3 Resilient Material Finish

Finish for resilient material shall be smooth texture with colors in accordance with SAE J 1545.

2.8 ADHESIVES

Adhesive for resilient material shall be in accordance with manufacturers recommendations.

2.9 COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Corner Guards and Wall Guards (Bumper Guards)

Material shall be mounted at location indicated in accordance with manufacturer's recommendations.

3.1.2 NOT USED

3.1.3 Stainless Steel Guards

a. Mount guards on external corners of interior walls, partitions and columns as shown.

b. Where corner guards are installed on walls, partitions or columns finished with plaster or ceramic tile, expansion bolted to concrete or masonry with four 10 mm diameter bolts, spaced 400 mm on centers. Coat back surfaces of corner guards, where shown, with a non-flammable, sound deadening material. Corner guards shall overlap finish plaster surfaces.

(1) Where corner guards are installed on exposed structural glazed facing tile units or masonry wall, partitions or columns, anchor corner guards to existing walls with 6 mm oval head stainless steel countersunk expansion or toggle bolts. Grout spaces solid between guards and backing with portland cement and sand mortar.

(2) Where corner guards are installed on gypsum board, clean surfaces and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from the guard edges and allow to cure undisturbed for 24 hours.

c. For wall guards, space brackets at no more than 900 mm on centers

and anchor to the wall in accordance with the manufacturer's installation instructions.

-- End of Section --

SECTION 10430A

EXTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 26/B 26M	(1999) Aluminum-Alloy Sand Castings
ASTM B 108	(1999) Aluminum-Alloy Permanent Mold Castings
ASTM B 209M	(2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221M	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	(2000) Recommended Practices for Resistance Welding
AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.2	(1997) Structural Welding Code - Aluminum

1.2 GENERAL

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.3 WIND LOAD REQUIREMENTS

Exterior signage shall be designed to withstand 58 km/h windload.

1.4 CHARACTER PROPORTIONS AND HEIGHTS

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, RE

Drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Modular Exterior Signage System; G, RE

Manufacturer's descriptive data and catalog cuts.

Installation

Manufacturer's installation instructions and cleaning instructions.

Exterior Signs; G, RE

Exterior signage schedule in electronic media with spread sheet

format. Spread sheet shall include sign location, sign type, and message.

Wind Load Requirements

Design analysis and supporting calculations performed in support of specified signage.

SD-04 Samples

Exterior Signs; G, RE

One 300 mm length of framing for signs. One sample of each type of sign. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Two samples of manufacturer's standard color chips for each material requiring color selection and 305 mm square sample of sign face color sample.

SD-10 Operation and Maintenance Data

Protection and Cleaning

Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed.

1.6 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.7 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.8 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of an identification sign located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown.

2.1.1 Free-Standing Base Mount Pylon/Monolith Type Signs

2.1.1.1 Framing

Interior framing shall consist of aluminum tube columns welded to companion plates. Perimeter framing shall consist of aluminum angle framing welded to the post and plate system as designed. Framing members shall be designed to permit panel removal. Mounting shall be provided as shown. Framing members of steel shall be finished with semi-gloss baked enamel or two-component acrylic polyurethane. Openings shall be sealed from moisture and made tamper-proof.

2.1.1.2 Exterior Sheeting Panels

Modular panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 2.3 mm thick aluminum. Panels shall be heliarc welded to framing system. Top and end panels shall be removable and shall be secured by 5 mm socket head jack nuts. Finish for metal panels shall be semi-gloss baked enamel or two-component acrylic polyurethane.

2.1.1.3 Mounting

Mounting shall be provided by securing to concrete foundation as shown.

2.1.1.4 Finishes

All exposed surfaces shall be finished with a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 605, with a primer coat of 0.005 to 0.008 mm (0.20 to 0.030 mils) and a color coat of minimum 0.025 mm (1.0 mils), total dry film thickness of 0.030 to 0.033 mm (1.2 to 1.3 mils). Finish shall be free of scratches and other blemishes. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.2 NOT USED

2.3 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.3.1 Graphics

Signage graphics shall conform to the following:

Cast dimensional aluminum letters, 13 mm thick with clear anodized finish shall be provided and fastened to the message panel with concealed fasteners. Letters shall project 13 mm from face of panel.

2.3.2 Messages

See drawing schedule for message content. Typeface: Helvetica medium. Type size as indicated.

2.4 NOT USED

2.5 NOT USED

2.6 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209M for sheet or plate, ASTM B 221M for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings. Aluminum extrusions shall be provided at least 3 mm thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1M/C1.1.

2.7 NOT USED

2.8 NOT USED

2.9 STEEL PRODUCTS

Structural steel products shall conform to ASTM A 36/A 36M. Sheet and strip steel products shall conform to ASTM A 570/A 570M. Welding for steel products shall conform to AWS D1.2.

2.10 NOT USED

2.11 NOT USED

2.12 NOT USED

2.13 NOT USED

2.14 NOT USED

2.15 NOT USED

2.16 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

2.17 SHOP FABRICATION AND MANUFACTURE

2.17.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A 123/A 123M and ASTM A 653/A 653M, as applicable. Other metallic coatings of steel sheet shall be

in accordance with ASTM A 924/A 924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.17.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.17.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

2.18 COLOR, FINISH, AND CONTRAST

Color of products shall be in accordance with Section 09915 COLOR SCHEDULE. For buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings. Circuits installed underground shall conform to the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Steel conduits installed underground and illuminated signage mounted directly on buildings shall be in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, the Contractor shall cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Signs shall be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

-- End of Section --

SECTION 10440A

INTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036	(1991; R 1997) Flat Glass

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G, RE

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Installation; G, RE

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Samples

Interior Signage; G, RE

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

a. Directional sign.

b. Door identification sign.

c. Restroom (Men or Women) with handicap symbol door identification sign.

d. Directional fire evacuation sign if these signs are required in accordance with local Fire Marshall and as coordinated with the Contracting Officer.

Two samples of manufacturer's standard color chips for each material requiring color selection.

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G, RE
Protection and Cleaning; G, RE

Six copies of operating instructions outlining the step-by-step procedures required for system operation shall be provided. The instructions shall include simplified diagrams for the system as installed. Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.3.1 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs

shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 75 mm .

1.3.2 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 0.8 mm upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 16 mm in height, but no higher than 50 mm. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 152 mm minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 EXTRA STOCK

The Contractor shall provide 5% of total extra frames and extra stock of the following: blank plates of each color and size for sign types, and changeable message strips for sign type.

PART 2 PRODUCTS

2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

Signs shall be fabricated of Type ES/MP laminated thermosetting plastic suitable for engraving or acrylic plastic conforming to ANSI Z97.1

2.1.1 Standard Room Signs

Signs shall consist of matte finish acrylic plastic or laminated thermosetting Type MP plastic. Units shall be frameless molded acrylic. Corners of signs shall be 10 mm radius.

2.1.2 Changeable Message Strip Signs

Changeable message strip signs shall consist of cast acrylic or Type ES plastic captive message slider sign face with message slots and associated end caps, as detailed, for insertion of changeable message strips. Size of signs shall be as shown on the drawings. Individual message strips to

permit removal, change, and reinsertion shall be provided as detailed. Corners of signs shall be 10 mm radius.

2.1.3 Type of Mounting For Signs

Extruded aluminum brackets, mounted as shown, shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be provided with countersunk mounting holes in plaques and mounting screws.

2.1.4 Graphics

Signage graphics for modular identification/directional signs shall conform to the following:

Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art shall be defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.

Graphics shall be raised 0.8 mm with background painted with low VOC paint or engraved exposed laminate.

2.2 BUILDING DIRECTORIES

Building directories shall be lobby directories or floor directories, and shall be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Dimensions, details, and materials of sign shall be as shown on the drawings. Where required, message content shall be as shown on drawings and schedule.

2.2.1 Header Panel

Message content shall be verified with Contracting Officer.

2.2.2 Doors

2.2.2.1 Door Glazing

Door glazing shall be in accordance with ASTM C 1036, Type 1, Class 1, Quality 3, minimum 3 mm thick.

2.2.2.2 Door Construction

Extruded aluminum door frame shall be of same finish as surrounding frame. Corners shall be mitered, reinforced, welded, and assembled with concealed fasteners. Hinges shall be standard with the manufacturer, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.2.2.3 Door Locks

Door locks shall be manufacturer's standard, and shall be keyed alike.

2.2.3 Fabrication

Extruded aluminum frames and trim shall be assembled with corners reinforced, welded, and mitered to a hairline fit, with no exposed fasteners.

2.2.4 Illuminated Units

Illuminated directory units shall have concealed internal back lighting with rapid start fluorescent tube lamp, internal wiring, and lead at wire for connection. Electrical work shall comply with NFPA 70 and shall be UL or FM listed.

2.2.5 Negative Graphics Header Panel

Directory shall consist of internally illuminated unit with backlit photo negative header and a black background. Unit shall have a tinted tempered safety solar glass door. Design of unit shall be as shown.

2.2.5.1 Construction

The directory shall be constructed of an aluminum 150 mm deep frame with satin dark bronze anodized finish. Unit shall be pedestal mounted. Unit shall have a 100 mm high header lettering as shown. Unit shall have a 9.3 mm face door frame with concealed hinges and locking system. Door frame shall be aluminum with satin dark bronze.

2.2.5.2 NOT USED

2.2.6 Changeable Letter/Illuminated Header Directory System

Directory shall consist of an internally illuminated header unit with felt grooved message background for changeable letters. Design of unit shall be as shown in the drawings.

2.2.6.1 Construction

The directory shall be constructed of an aluminum 138 mm deep frame with satin dark bronze anodized finish. Unit shall be pedestal mounted. Unit shall have a 100 mm high header with lettering as shown. Unit shall have a 9.3 mm face concealed hinge door and locking system with tempered safety glass. Door frame shall be aluminum with satin dark bronze finish.

2.2.6.2 Changeable Letters

Namestrips shall be felt grooved background with changeable upper and lower case Helvetica Medium 8 mm high letters and numbers. 3 sets of tabbed vinyl letters, numbers and punctuations shall be furnished per manufacturers set containing 250 characters.

Each set of 250 characters is broken down as follows:

A.....12	O.....12	1.....6
B.....6	P.....5	2.....6
C.....7	Q.....2	3.....6
D.....6	R.....10	4.....6
E.....14	S.....10	5.....6
F.....4	T.....9	6.....6
G.....4	U.....7	7.....6
H.....6	V.....3	8.....5
I.....12	W.....5	9.....5
J.....3	X.....2	0.....10
K.....3	Y.....6	--.....2
L.....7	Z.....2	10
M.....6	&.....2	,.....7
N.....8		

2.3 METAL PLAQUES

2.3.1 Cast Metal Plaques

2.3.1.1 Fabrication

Cast metal plaques shall be provided by the Government.

2.3.1.2 NOT USED

2.3.1.3 NOT USED

2.3.1.4 Mounting

Mounting shall be concealed rosettes and anchors.

2.3.2 NOT USED

2.3.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 FABRICATION AND MANUFACTURE

2.8.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.9 COLOR, FINISH, AND CONTRAST

Color shall be in accordance with Section 09915 COLOR SCHEDULE. In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Illuminated signage shall be in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 75 mm of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 2 mm thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 0.13 mm green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware

and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

SECTION 10508R

METAL WARDROBE LOCKERS AND BENCH SEAT

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A653	Standar Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy Coated (Galvanized) by the Hot-Dip Process.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Provide data on locker types, sizes and accessories.

Lockers: See Section 09915 COLOR SCHEDULE.; G, RE

Locker Manuf. Product submitted as an "or equal"; G, RE

Bench Seat: See Section 09915 COLOR SCHEDULE; G, RE

Bench Seat Manuf. Product submitted as an "or equal"; G, RE

SD-02 Shop Drawings

Shop Drawings.; G, RE

Indicate locker plan layout, numbering plan and key codes.

SD-04 Samples

Samples; G, RE

Submit two samples 75 x 150 mm in size, of each color selected; applied to specified base metal.

1.3 DELIVERY, STORAGE, AND PROTECTION

Transport, handle, store, and protect products.

Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MATERIALS

Designer to determine what type of lockers are required and edit this list as needed.

2.1.1 Sheet Steel

ASTM A653 Grade D, Coating Designation G90, stretcher leveled; to the following minimum thicknesses:

1.	Body and Shelf:	24 gage
2.	Door Outer Face:	16 gage
3.	Door Inner Face:	20 gage
4.	Door Frame:	16 gage
5.	Hinges:	14 gage
6.	Base:	18 gage
7.	Sloping Top:	18 gage
8.	Trim:	20 gage

2.1.2 Single Tiered Locker

Size 300mm wide, 375mm deep, 1800mm high (Dust covers around the entire perimeter of the base will increase height by 150mm to 1950mm.) Provide dust covers with sloped tops and end covers to preclude dust accumulation. End panels as required per drawing configuration. Maximum size of grouping units is three lockers per unit. Latch hook to have bevel on front upper edge to allow latch clip to ride up slope as door closes. Steel door frames of minimum 16 gauge metal with three hinges of minimum 14 gauge steel. Vertical members shall have an additional flange to form continuous door strike. Minimum gauge for top, bottom, shelves, sides, back and row ends of 20 gauge steel. Eyelet for padlock must accept a 7.9mm padlock shank, providing a secured locking three point latching mechanism. Lockers will be sequentially numbered with a plate beginning with #1. Locker will contain a single shelf at top with hanging rod and wall hooks on both sides. Ventilation is by airflow slots in the top and bottom flange of door. Lockers are to be installed in the room with dust covers installed.

2.1.3 Double Tiered Locker

Size 300 mm wide, 375 mm deep, 1800 mm high. Provide dust covers with sloped tops and end covers to preclude dust accumulation. End panels as required per drawing configuration. Maximum size of grouping units is three lockers per unit. Latch hook to have bevel on front upper edge to allow latch clip to ride up slope as door closes. Steel door frames of minimum 16 gauge metal with three hinges of minimum 14 gauge steel. Vertical members shall have an additional flange to form continuous door strike. Minimum gauge for top, bottom, shelves, sides, back and row ends

of 20 gauge steel. Eyelet for padlock must accept a 7.9mm padlock shank, providing a secured locking three point latching mechanism. Lockers will be sequentially numbered with a plate beginning with #1. Locker will contain a single shelf at top with hanging rod and wall hooks on both sides. Ventilation is by airflow slots in the top and bottom flange of door. Lockers are to be installed in the room with dust covers installed.

2.2 ACCESSORIES

2.2.1 Lockers

Each All Metal, Quiet Type Wardrobe Locker: Two double prong wall hooks, coat hanger bar, rubber bumper.

2.2.2 Locker Benches

Stationary free standing type; bench top of laminated maple species wood, stained, sealed and varnished; pedestals of chrome steel 444.5 mm.

2.3 FABRICATION

2.3.1 Locker Unit

Locker Units:	Configuration and size as previously indicated.
Mounting:	Surface mounted.
Base:	Metal base.
Base Height:	100mm.
Top:	Sloped metal with closures.
Ventilation Method:	Air flow slots in the top and bottom flange of door.
Class:	Quiet

2.3.2 Locker Body

Formed and flanged; with steel stiffener ribs; electric spot welded.

2.3.3 Frames

Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.

2.3.4 Doors

Hollow channel construction, 30mm thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth. Provide ventilation openings at top and bottom of each locker. Form recess for operating handle and locking device.

2.3.5 Hinges

Two for doors under 1050mm high; three for doors over 1050mm high; weld securely to locker body and door.

2.3.6 NOT USED

2.3.7 Number Plates

Provide oval shaped aluminum plates. Form numbers 12.7 mm high of block font style, in contrasting color.

2.3.8 Ends and Closure

Fabricate ends and closure pieces as required to create locker units in configuration as indicated on the drawings.

2.3.9 Base

Fabricate 100mm high steel bases with end closures.

2.3.10 Door Handle and Latching

Handles shall be recessed in the door and be finger lift control. The 20 gauge drawn pocket shall be brushed stainless steel securely fastened to the door with two tabs plus a positive tamper resistant decorative fastener. The pocket shall be of sufficient depth to prevent a combination padlock from protruding beyond the face of the door. A lock hole cover plate shall be provided for use with padlocks.

The lifting piece shall be 14 gauge formed steel, attached to the latching channel with one concealed retaining lug and one rivet assuring a positive two point connection. Handle finger lift shall have a padlock eye for use with a 9/32" diameter padlock shackle. It shall have a sound deadening molded comfortable finger lift attached.

Doors to have latch clip engaging the door frame at three points on 60" & 72" high and two points on 20" through 36" high doors. One rubber silencer at each heavy gauge latch hook. Latch clips shall be glass filled nylon for long life and low friction and shall hold doors shut by engaging the latch hooks. The latch channel assembly shall be quieted by the use of unique nylon glides to reduce noise.

2.3.11 Interior Equipment

Single tier lockers 60" or higher shall have a hat shelf located approximately 9" below the top of locker; if less than 18" deep, locker shall have three single-prong ceiling hook. Single tier lockers 18" or more in depth shall have a coat rod instead of a ceiling hook. 30" & 36" high lockers shall have three single-prong wall hooks and one double-prong ceiling hook. Hooks to be steel, ball tip zinc plated, attached with two bolts per hook. 20" & 24" high lockers to have three wall hooks for 12" wide and four wall hooks for 15" and wider.

2.4 FINISHES

Lockers to be factory finished with two coats of baked enamel. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that prepared bases and embedded anchors are properly sized and are in the correct position and configuration.

3.2 INSTALLATION

3.2.1 Lockers

Install in accordance with manufacturer's instructions. Install lockers plumb and square. Secure lockers with anchor devices to suit substrate materials at floor and/or wall with a minimum Pullout Force of 445N. Bolt adjoining locker units together to provide rigid installation. Install end panels, filler panels, sloped tops, bases and accessories. Replace components that do not operate smoothly or have been damaged or dented. Touch up any scratches.

3.2.2 Bench Seat

Install benches with anchor devices to suit substrate material with minimum pullout force of 445N.

3.3 CLEANING

Cleaning installed work. Clean locker interiors and exterior surfaces.

---END OF SECTION---

SECTION 10522R

FIRE EXTINGUISHERS AND CABINETS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NFPA 10	Portable Fire Extinguishers.
ANSI/UL 711	Rating and Fire Testing of Fire Extinguishers.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Fire Extinguisher Cabinet Product Data; G, RE

Provide cabinet and extinguisher operational features, color and finish, and anchorage details.

Maintenance Data

Include test, refill or recharge schedules and re-certification requirements.

Acceptable Manufacturer Products

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

Fire Extinguisher Cabinets (FEC)

FEC: J. L. Industries
4450 W. 78th St. Circle
Bloomington, MN 55435,
952-835-6850

FEC: Larsen's Manufacturing Company
7421 Commerce Lane N.E.
Minneapolis, MN
800-527-7367

FEC: Potler-Roemer
16833 Edwards Rd.,
Cerritos, CA 90701-2417
310-404-3753

FEC: Manuf. Product submitted as an "or equal"; G, RE.

SD-04 Drawings

Shop Drawings

Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, and location.

1.3 COORDINATION

Fire extingusihers shall also be provided. Fire extinguisher shall be 9.46 liter size minimum and shall meet NFPA 10 requirements. Coordinate size of cabinet and extinguisher. Coordinate installation of fire extinguishers prior to contract completion. Coordinate the exact location of cabinet with other work.

1.4 QUALITY ASSURANCE

Provide units conforming with ANSI/UL 711.

1.5 REGULATORY REQUIREMENTS

Conform to ANSI/NFPA 10 for requirements for extinguishers.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 CABINETS

Designer to determine type of extinguisher, depth required and selection of trim.

2.1.1 Fire Extinguisher

Trimless recessed or semi-recessed steel cabinet with baked enamel finish. Steel door shall be red baked solid type, 30 gage with white silk screened words: "Fire Extinguisher" arranged vertically. Cabinet shall be sized to accommodate a 9.46 liter, pressurized water-type fire extinguisher.

2.1.1.1 Cabinet mounting hardware:

Shall be as standard with the manufacturer.

2.2 ACCESSORIES

Extinguisher Brackets: Formed steel, white enamel finish.

Cabinet Signage: Fire Extinguisher.

2.3 FABRICATION

Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.

Pre-drill for anchors.

Hinge doors for 180 degree opening with continuous piano hinge. Provide nylon roller type catch.

Weld, fill, and grind components smooth.

2.4 FINISHES

Cabinet Exterior Trim and Door: Baked enamel, color as indicated.

Cabinet Interior: Baked enamel.

PART 3 EXECUTION

3.1 EXAMINATION

Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

Install in accordance with manufacturer's instructions and drawings.

Install cabinets plumb and level in wall openings, located from finished floor as indicated.

Secure rigidly in place.

Position cabinet signage on door to cabinets.

-- End of Section --

SECTION 10530R

MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Mail Boxes; G, RE

Mooring Eye Floor Casting; G, RE

Drawings showing construction and installation details.

SD-03 Product Data

Product certification and installation recommendation data.

Acceptable Manufacturer Products

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification or Section 09915 is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

Mail Boxes: See Section 09915 COLOR SCHEDULE

Mail Box Manuf.; G, RE

Mooring Eye Floor Casting: Neenah Foundry Co. No. R-3490-F.
Box 729
Neenah,WI 54957 414-725-7000

Mooring Eye Manuf. Product submitted as an "or equal"; G, RE

SD-04 Samples

Color Charts

Submit color chart for mailbox.

1.2 DELIVERY AND STORAGE

All items shall be delivered to the project site in manufacturer's undamaged containers.

1.3 WARRANTY

Provide manufacturer's standard warranty for the items.

PART 2 PRODUCTS

2.1 MAILBOXES

2.1.1 General

Mailboxes shall be U.S. Postal Service approved. Mailboxes, materials, sizes, construction, and installation shall comply with U.S. Postal Service regulations and shall be fully approved by the U.S. Postal Service.

2.1.2 Materials

Quantities and arrangement of mailboxes shall be as indicated on the drawings. Mailboxes shall be rear-loading type with sheet aluminum rear door with a continuous piano hinge on one side and a keyed lock on the other side strengthened with formed sheet aluminum stiffeners. Framework supporting compartment doors shall be fabricated from high strength extruded aluminum alloy. Compartment doors shall be fabricated from high strength extruded aluminum alloy, with a minimum of 3.2 mm thickness, and swing on concealed hinge pins. The compartment door shall be double wide to accept minimum 225mm x 280mm size mail without bending. When closed, the door shall interlock with frame member along hinge side and shall be precision fitted to preclude prying. Doors shall be reinforced vertically along both sides and near center with integral ribs. Locks on individual compartment doors shall be springlatch type lock actuated by a cam type lock with two change keys per lock and a minimum of 1000 available key changes. All locks within project shall be keyed differently. Compartment construction shall be double-walled high strength sheet aluminum alloy with vertical stiffeners of formed aluminum. Finish shall be as indicated on drawings. Mail box manufacturer shall furnish aluminum channel type cardholders with pressure sensitive backing to accommodate 11.1 mm by 63.5 mm cards for individual and/or unit names.

2.1.3 Color

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.2 SECURITY MESH

Security mesh shall be a minimum of 1.8mm thick and weigh a minimum of 3.66kg/sq. m. The mesh shall be diamond type with a minimum of 73 percent open area. The overall mesh size and orientation shall be as recommended by

the manufacturer.

2.3 MOORING EYE

Mooring eye shall be a standard casting product constructed of ductile iron and made to be installed in concrete with top of casting flush with top of finish concrete.

PART 3 EXECUTION

3.1 INSTALLATION

Install all items in strict accordance with manufacturer's recommendations at the locations indicated on the drawings. Align and plumb all items with adjacent surfaces and set accurately in location.

3.2 PROTECTION AND CLEANING

Protect the work from other trades and remove all protective wrappings when appropriate. Clean all surfaces in accordance with manufacturer's recommendations.

-- End of Section --

SECTION 10552R

METAL STORAGE SHELVING

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, RE

Submit shop drawings showing location, ranges and extent of metal shelving systems. Show installation details at any special or non-standard conditions.

Initial Selection Purposes: Submit manufacturer's standard size samples of colors and finishes.

Verification Purposes: Submit 6" square samples of each color and finish required. Prepare from same material to be used for the work.

SD-03 Product Data

Acceptable Manufacturer Products

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

Shelving: Penco Products Inc.
99 Brower Avenue
P. O. Box 378
Oaks, PA 19456-0378
800.562.1000
www.pencoproducts.com

Shelving: Republic Storage Systems Co., Inc.

1038 Beldon Avenue, NE
Canton, OH 44705
800.477.1255
www.republicstorage

Shelving: Manuf. Product submitted as an "or equal"; G, RE.

SD-04 Samples

Metal Shelving; G, RE

Manufacturer's standard color samples of specified finishes.

1.2 QUALITY ASSURANCE

1.2.1 Manufacturer Qualifications

Firm (material producer) with not less than 3 years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.

1.2.2 Installer Qualifications

Firm specializing in metal storage shelving installation with not less than 2 years of experience in installation of metal storage shelving similar to that required for this project.

1.2.3 Single Source Responsibility

Provide material produced by a single manufacturer for each shelving unit type.

1.3 DELIVERY, STORAGE AND HANDLING

Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.4 WARRANTY

Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace shelving units which fail in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Government may have against the Contractor under the Contract Documents.

Warranty period is 2 years after the date of Substantial Completion.

1.5 MAINTENANCE

1.5.1 Maintenance Instructions

Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum

condition under anticipated use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.

1.5.2 Replacement Materials

After completion of work, deliver not less than 2 of each type, color, and pattern of metal storage shelving, exclusive of material required to properly complete installation. Furnish 2% of accessory components as scheduled. Furnish replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

Minimum 20 gauge cold-rolled steel sheet metal, washed to receive powder coated baked enamel finish, higher gauge where indicated to provide appropriate loading capacity. Shelving shall meet the requirements of ANSI MH28.1.

2.1.2 NOT USED

2.1.3 Closed Shelving

Provide heavy-duty closed shelving units consisting of four upright corner pilasters, slotted to receive clips clipped together with shelves as indicated. Provide end and back panels as required for stability. Shelves to be adjustable at 38.1 mm on center. Provide 900 mm wide by 2200 mm high units, unless otherwise indicated on drawings or in specifications.

Provide number of shelves as indicated of standard 450mm depth.

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 End Panels (For Closed Shelving)

Shall be 24 guage steel. Each side shall be punched with holes for bolting to posts.

2.1.7 Back Panels (For Closed Shelving)

Shall be 24 guage steel with holes on each side for bolting to angle posts and in the middle for using a back panel clip.

2.1.8 Lengthwise Dividers

Steel gauge as required by shelf spacing.

2.1.9 Bases

Channel-shaped to engage upright T sections with spring fasteners, minimum 20 gauge for 75mm base, minimum 18 gauge for 150mm base.

2.2 FINISHES

Provide units in finishes and colors as selected by the Contracting Officer from manufacturer's standard finishes and colors.

PART 3 EXECUTION

3.1 INSPECTION

Inspect areas and conditions in which metal storage shelving will be installed. Verify locations of power feeds, positioning of exits and aisle ways and overall dimensions of space, including height and HVAC venting.

3.2 PREPARATION

Prior to installation of shelving system, vacuum floor surface to remove dust, debris and loose particles. Resilient flooring wet mopped and dried or finish buffed. Verify that components, including size and finish are those specified before installing.

3.3 INSTALLATION

Install shelving system and accessories after finishing operations, including painting have been completed. Install system to comply with final layout drawings, in strict compliance with manufacturers printed instructions. Position units level, plumb; at proper location relative to adjoining units and related work. Adjust accessories to provide visually acceptable installation.

3.4 FIELD QUALITY CONTROL

Remove and replace shelving components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Provide new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.5 ADJUST

Adjust components and accessories to provide visually acceptable installation.

3.6 CLEANING

Immediately upon completion of installation, clean components and surfaces following manufacturer's recommended procedures.

Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.7 DEMONSTRATION

Upon completion of installation of system, inspect and determine capability and compliance with requirements. Repair or replace units which are not functional. All shelves and/or accessories shall be smoothly in place with no visual buckling or non-alignment of parts evident.

3.8 PROTECTION

Protect system against damage during remainder of construction period. Advise owner of additional protection needed to ensure that system will be without damage or deterioration at time of Substantial Completion.

---END OF SECTION---

SECTION 10605N

WIRE MESH PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673 (1986) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1996) Carbon Structural Steel

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Wire mesh partitions; G, RE

Show layout, details, materials, dimensions, finishes, and all information necessary for fabrication and installation.

SD-03 Product Data

Wire mesh partitions; G, RE

Submit for each type of partition, door, and window.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials in manufacturer's original, unopened containers or packaging with labels intact and legible. Deliver, store, and handle materials so as to prevent damage. Replace damaged or defective materials with new.

1.4 DESCRIPTION OF WORK

Wire mesh partitions shall be normal duty for normal industrial use, and shall be provided complete with fasteners, cappioing bars, adjustable floor sockets, bracing, doors, hardware, and other items necessary for a complete, useable, and rigid installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Shapes, Plates, and Bars

ASTM A 36/A 36M.

2.1.2 Cold-Formed Steel

AISI SG-673.

2.1.3 Wire Mesh

Carbon steel wire, woven diamond or rectangular mesh, intermediate crimped.

2.1.4 Floor Sockets

Cast or forged steel or ductile iron, adjustable, approximately 64 mm high.

2.2 NORMAL DUTY PARTITIONS

2.2.1 Wire Mesh

10 gage wire, 38 mm mesh or 10 gage wire, 50mm x 25mm retangular woven wire.

2.2.2 Vertical Frames

32 by 16 mm cold-rolled C section channels, 32 by 16 by 3 mm channels or 32 by 32 by 3 mm angle with mesh securley welded to frame with flat steel stiffeners welded to frame behind mesh panels longer than 1.066 M.

2.2.3 Horizontal Frames

25 by 16 mm channels or 32 by 32 by 3 mm angle with mesh securley welded to frame with flat steel stiffeners welded to frame behind mesh panels longer than 1.066 M.

2.2.4 Center Reinforcing Bar

One 25 by 13 by 3 mm channel with all wires woven through, or two 25 by 10 by 3 mm channels bolted together with mesh in between.

2.2.5 Capping Bar

56 by 25 by 3 mm channel or 50 by 6 mm flat bar.

2.2.6 Corner Posts

Structural steel angles, 32 by 32 by 3 mmor 50 by 50 mm by 14 gage square tubing with 6 by 50 by 177 mm plate welded at base of post.

2.2.7 Line Posts

Unless otherwise indicated, provide partitions more than 3600 mm high with flat bar line posts bolted between vertical frame channels or 50 by 50 mm by 14 gage square tubing with 6 by 50 by 177 mm plate welded at base of post. Sizes of posts shall be as follows:

Partition Height	Size of Posts
3600 to 4400 mm	44 by 7.9 mm or 50 by 6 mm
4400 to 5900 mm	63 by 7.9 mm
5900 to 7100 mm	75 to 7.9 mm

2.2.8 Hinged Doors

Frames shall be 32 by 13 by 3 mm channels with 32 by 3 mm flat bar cover on top and bottom rails and on hinge stile and a 35 by 20 by 3 mm angle riveted to the lock stile. Provide 1 1/2 pairs of regular weight, wrought steel, non-removable pin, butt hinges riveted or welded to the door and the door opening frame for each door or 32 by 32 by 3 mm angle with mesh securley welded to frame with flat steel stiffeners welded to frame for extra strength where needed. Provide 100 by 100 mm five knuckle tight non-removable pin hinges.

2.2.9 Sheet Metal Base

Hot- or cold-rolled sheet steel, not lighter than 16 gage.

2.3 NOT USED

2.4 SLIDING DOORS

Frames shall be 38 by 20 by 3 mm channels with 38 by 3 mm flat bar cover all around or 32 by 32 by 3 mm angle with mesh securley welded to frame with flat steel stiffeners welded to frame for extra strength where needed. Provide two four-wheel, roller bearing hangers and steel box track for each door.

2.5 DOOR OPENING FRAMES

Provide frames the same size and shape as the vertical frames for the mesh panels.

2.6 NOT USED

2.7 NOT USED

2.8 FABRICATION

2.8.1 Standard Panels

Wire shall be woven into diamond or rectangular mesh, intermediate crimped, and securely clinched or welded to frames. Joints shall be mortised and tenoned. Wire shall be continuous at center reinforcing bars, either woven

through a single channel or bolted between two channels. Panel vertical frames shall have 6 mm bolt holes 300 mm o.c. for normal duty partitions.

2.8.2 Sheet Metal Base Panels

Upper portion shall be as specified for standard panels, except that the wire shall be clinched into the center reinforcing bar. Form sheet steel to fit between the panel frames and securely bolt to the frames.

2.8.3 Doors and Service Windows

Construction shall be similar to that specified for panels. Wire mesh shall be the same as that used in the adjacent partition panels.

2.8.4 Finish

Thoroughly clean ferrous metal, treat with phosphate, and paint with gray enamel in the shop.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wire Mesh Partitions

Install plumb, level, and true to line, within a tolerance of 3 mm in 3 m or the height or run of the partition, if less than 3 meters. Anchor floor sockets to the floor with expansion bolts. Vertical frames and posts shall be bolted together with 6 mm bolts 300 mm o.c. for normal duty partitions. Secure top frames to a continuous capping bar with 6 mm diameter U bolts not more than 650 mm o.c.

3.1.2 Doors

Install in accordance with the manufacturers' recommendations. Adjust as required so that doors and hardware operate freely and properly.

3.1.3 Bracing

Brace free standing partitions more than 6 meters in length, at intervals not greater than 6 meters with a steel channel brace connected to the capping bar and anchored to the building wall or framing member or with a structural steel I section or tube post welded to a 225 by 225 mm steel base plate anchored to the floor with 4 expansion bolts.

3.1.4 Touch-Up

Clean and paint scratches, abrasions, and other damage to shop painted surfaces to match the shop-applied finish.

-- End of Section --

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SECTION 10753R

WALL-MOUNTED TELEPHONE ENCLOSURES

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickle Steel Plate, Sheet, and Strip.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings ; G, RE

Indicate location and anchorage detail of telephone enclosures to wall construction.

SD-03 Product Data

Provide construction data on telephone enclosure

Acceptable Manufacturer Products

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

American Specialties, Inc. Product: Tellette 1310-SH
Yonkers, NY.
914.476.9000

PBG, Inc. Product: PB-101/Indoor Enclosure
401.423.3738
www.PBGinc.com

Redy Ref Pressed & Welded, Inc. Product: MS 2200-CF
800.628.3603
www.redyref.com

Telephone Encl., Manuf. Product submitted as an "or equal"; G, RE.

SD-07 Certificates

Certificate

Certification that enclosure meets standards.

1.3 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.4 FIELD MEASUREMENTS

Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Stainless Steel Plate, Sheet and Strip

Provide stainless steel plate, sheet, or strip, A151 type 302 or 304. Comply with requirement of ASTM A 167.

2.1.2 Perforated Panels

Provide panels with not less than 1000 perforations per square foot for acoustical panels.

2.1.3 Acoustical Material

Provide non-flaking or enamel glass fiber sound absorption blankets or boards.

2.2 WALL-MOUNTED, SHELF TYPE TELEPHONE ENCLOSURES

2.2.1 General

Provide wall mounted, shelf type telephone enclosure units of the style indicated.

Provide groupings of enclosures with a common divider wall between adjacent units.

2.2.2 Enclosure Body

Provide surface-mounted, shelf-type telephone enclosures of the size and

style indicated. Enclosures shall consist of an acoustic rear wall panel containing the telephone instrument, side walls, and a writing shelf.

a. Side Walls: Stainless steel acoustic panels.
b. Shelf: Full-length stainless steel writing shelf.

2.3 ACCESSORIES

2.3.1 Telephone Type

Bell Type 1 standard box-type, coin-operated telephone instrument.

2.3.2 Inserts and Anchorages

Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of units. Coordinate delivery of inserts and anchoring devices with other work to avoid delaying installation.

2.3.3 Fasteners

Provide screws, bolts, and other exposed fastening devices of the same material as the items being fastened. Fasteners for application on the exterior and exposed to the weather may be hot-dip galvanized, stainless steel, or aluminum. Provide types, gages, and lengths to suit installation conditions. Use theft-proof fasteners where exposed to view.

2.4 FABRICATION

2.4.1 Construction

Fabricate telephone enclosures to requirements indicated. Provide units square, rigid, and without warp, with metal edges flat and free of dents or distortion. Make exposed metal edges safe to touch. Weld members together to firm a rigid one-piece structure. Grind exposed welds flush.

2.4.2 Shop Assembly

Preassemble telephone enclosures in the shop to the greatest extent possible, to minimize assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

2.5 FINISHES

2.5.1 General

Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

2.5.2 Stainless Steel Finishes

Finish designations prefixed by "AISI" conform to the system established by the American Iron and Steel Institute for designating finishes.

2.5.3 Bright, Directional Polish Finish

AISI Type 302 or 304 with No. 4 directional polish finish.

Grain Direction: Horizontal

PART 3 EXECUTION

3.1 INSTALLATION

Install telephone enclosures and related accessories at locations shown in accordance with manufacturer's instructions. Provide clips, grounds, backing materials, brackets and anchors, trim and accessories necessary for a complete installation.

3.2 ADJUST AND CLEAN

Replace units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended by the manufacturer.

-- End of Section --

SECTION 10800R

TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A117.1	Safety Standards for the Handicapped.

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
ASTM A269	Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
ASTM A366	Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Toilet and Shower Accessories; G, RE

Provide manufacturer's data on all accessories describing size, finish, details of function, attachment methods.

Acceptable Manufacturer Products

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in

this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

Bobrick Washroom Equipment, Inc.

Toilet and Bath Manuf. Products submitted as an "or equal"; G, RE.

SD-08 Manufacturer's Instructions

Toilet and Bath Accessories

Indicate manufacturer's installation procedures, perimeter conditions requiring special attention, and anchorage.

1.3 REGULATORY REQUIREMENTS

Conform to ANSI A117.1 code for access for the handicapped.

1.4 FIELD MEASUREMENTS

Verify that field measurements are as indicated on product data.

1.5 COORDINATION

Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Sheet Steel:

ASTM A366.

2.1.2 Stainless Steel Sheet:

ASTM A167, Type 304.

2.1.3 Tubing:

ASTM A269, stainless steel.

2.1.4 Adhesive:

Two component epoxy type waterproof.

2.1.5 Fasteners, Screws, and Bolts:

Hot dip galvanized, tamper-proof, and security type.

2.1.6 Expansion Shields:

Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.2 FABRICATION

Weld and grind joints of fabricated components, smooth.

Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.

Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with minimum 38.1mm clearance from wall surface. All grab bar installations shall withstand forces in excess of 13.4 kN.

Shop assemble components and package complete with anchors and fittings.

Provide steel anchor plates, adapters, and anchor components for installation.

2.3 KEYING

Supply 2 keys for each accessory to Contracting Officer.

Master key all accessories.

2.4 FINISHES

2.4.1 Galvanizing:

ASTM A123 to 42.36g/sq. m. Galvanize ferrous metal and fastening devices.

2.4.2 Shop Primed Ferrous Metals:

Pretreat and clean, spray apply one coat primer and bake.

2.4.3 Stainless Steel:

All metal appearance finishes shall be No. 4 satin luster finish.

2.4.4 Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings.

Verify exact location of accessories for installation.

3.2 PREPARATION

Deliver inserts and rough-in frames to site for timely installation.

Provide templates and rough-in measurements as required.

3.3 INSTALLATION

Install accessories in accordance with manufacturers' instructions and ANSI A117.1.

Install plumb and level, securely and rigidly anchored to substrate at the locations indicated on the drawings.

3.4 SCHEDULE

3.4.1 A1, Utility Shelf with Mop/Broom Holder and Rag Hooks

(Bobrick Model B-239)

Utility shelf with mop and broom holder and rag hooks shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Shelf shall be 18 gauge, 200 mm deep with 19 mm return edges and shall have front edge hemmed for safety. Unit shall be 1115 mm long with 5-16 gauge hooks and a spring-loaded rubber cam holders.

3.4.2 A2, Recessed Paper Towel Dispenser and Waste Receptacle

(Bobrick Model B-3803)

Recessed paper towel dispenser and waste receptacle shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Door shall be 1.2 mm; have 14 mm, 90 deg. return edges; be secured to cabinet with a concealed, full-length stainless steel piano-hinge; and equipped with a stainless steel cable door-swing limiter and two tumbler locks keyed like other washroom accessories. Paper towel dispenser shall be capable of dispensing 600 C-fold, 800 multifold, or 1100 singlefold paper towels. Waste receptacle shall be furnished with a removable, leak-proof, rigid molded plastic waste-container with a capacity of 24.0L.

3.4.3 NOT USED

3.4.4 NOT USED

3.4.5 A5, Recessed Toilet-Seat-Cover Dispenser, Sanitary Napkin Disposal and Toilet Tissue Dispenser

(Bobrick Model B-3574)

Recessed toilet-seat-cover dispenser, sanitary napkin disposal, and toilet tissue dispenser shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Toilet tissue dispensers shall be ABS plastic with a type-304 stainless steel waste deflector attached to the top tissue dispenser. Flange shall be drawn and

beveled, one-piece, seamless construction. Unit shall mount flush against side wall of barrier-free toilet compartment to allow clearance for grab bar across front of unit. Door shall be one-piece, seamless construction; secured to cabinet with a full-length stainless steel piano-hinge; and equipped with a tumbler lock keyed like other washroom accessories. Toilet-seat-cover dispenser shall fill from below the internal shelf and hold 500 paper covers. Self-closing disposal panel shall be secured to door with a spring-loaded, full-length stainless steel piano-hinge and equipped with an international graphic symbol identifying napkin disposal. Sanitary napkin disposal shall be furnished with a removable, leak-proof, molded polyethylene receptacle with a capacity of 3.0 L. Unit shall be equipped with two theft-resistant, high-impact polystyrene toilet tissue spindles that hold standard-core rolls up to 135 mm diameter (1800 sheets). Spindle shall have a concealed locking mechanism opened with special key furnished.

3.4.6 A6, Recessed Toilet-Seat-Cover and Toilet Tissue Dispenser

(Bobrick Model B-3474)

Recessed toilet-seat-cover and toilet tissue dispenser shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Toilet tissue dispenser shall be ABS plastic. Flange shall be drawn and beveled, one-piece, seamless construction. Unit shall mount flush against side wall of barrier-free toilet compartment to allow clearance for grab bar across front of unit. Door shall be one-piece, seamless construction; secured to cabinet with a full-length stainless steel piano-hinge; and equipped with a tumbler lock keyed like other washroom accessories. Toilet-seat-cover dispenser shall fill from below the internal shelf and hold 500 paper covers. Unit shall be equipped with two theft resistant, heavy-duty ABS toilet tissue spindles that hold standard-core rolls up to 135 mm diameter (1800 sheets). Spindle shall have a concealed locking mechanism opened with special key furnished.

3.4.7 A7, Partition-Mounted Toilet-Seat-Cover Dispenser, Sanitary Napkin Disposal, and Toilet Tissue Dispenser

(Bobrick Model B-357)

Partition-mounted toilet-seat-cover dispenser, sanitary napkin disposal, and toilet tissue dispenser shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Toilet tissue dispenser shall be ABS plastic. Flanges shall be drawn and beveled, one-piece, seamless construction. Unit shall mount in partition and serve two toilet compartments. Door shall be one-piece, seamless construction; secured to cabinet with a full-length stainless steel piano-hinge; and equipped with two tumbler locks keyed like other Bobrick washroom accessories. Self-closing disposal panels shall be secured to cabinet with spring-loaded, full-length stainless steel piano-hinges and equipped with international graphic symbols identifying napkin disposal. Napkin disposal shall be furnished with a removable, leak-proof, molded polyethylene receptacle with a capacity of 3.0 L. Toilet-seat-cover dispenser and sanitary napkin disposal shall be serviced from one side only. Toilet-seat cover dispenser shall be equipped with a plastic sight-barrier panel and

hold 1000 paper covers. Unit shall be equipped with four theft resistant, heavy-duty ABS toilet tissue spindles that hold standard-core rolls up to 135 mm diameter (1800 sheets). Spindle shall be removable from cabinet only when door is open.

3.4.8 NOT USED

3.4.9 A9, Surface-Mounted Toilet-Seat-Cover and Toilet Tissue Dispenser

(Bobrick Model B-3479)

Surface-mounted toilet-seat-cover and toilet tissue dispenser shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Toilet tissue dispenser shall be ABS plastic. Flange shall be drawn and beveled, one-piece, seamless construction. Unit shall be mounted on side wall of single toilet compartment. Door shall be one-piece, seamless construction. Unit shall be mounted on side wall of single toilet compartment. Door shall be one-piece, seamless construction; secured to cabinet with a full-length stainless steel piano-hinge; and equipped with two tumbler locks keyed like other washroom accessories. Toilet-seat-cover dispenser shall hold 1000 paper covers. Unit shall be equipped with two theft-resistant, heavy-duty ABS toilet tissue spindles that hold standard-core rolls up to 135 mm diameter (1800 sheets). Spindles shall be removable from cabinet only when door is open.

3.4.10 A10, Surface-Mounted Toilet-Seat-Cover Dispenser

(Bobrick Model B-221)

Surface-mounted toilet-seat-cover dispenser shall be type-304, 0.8 mm stainless steel with all-welded construction; exposed surfaces shall have satin finish. Dispenser shall have a concealed opening in bottom for filling. Capacity shall be 250 paper toilet seat covers.

3.4.11 NOT USED

3.4.12 A12, Recessed Sanitary Napkin/Tampon Vendor

(Bobrick Model B-3500C)

Recessed sanitary napkin/tampon vendor shall combine two dispensing mechanisms in one cabinet to provide sanitary napkins or tampons at user's option. Dispensing mechanisms shall be convertible in the field to allow the change of coin denomination without purchasing new mechanisms or removing unit from wall. Door shall be furnished with metal plates indicating specified coin denomination. Unit shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Door shall be 1.2 mm; have 22 mm 90 deg. return edges; be secured to cabinet with a concealed, full-length stainless steel piano-hinge; and equipped with a stainless steel cable door-swing limiter and two tumbler locks keyed like other washroom accessories. Pull knobs shall be operable with one hand and with less than 22.2 N of force to comply with barrier-free accessibility guidelines (including ADAAG in USA). Each coin box shall be equipped with a tumbler lock that is keyed differently than

door locks. Unit shall not carry brand-name advertising.

3.4.13 NOT USED

3.4.14 A14, Heavy-Duty Shower Curtain Rod

(Bobrick Model B-6107)

Shower curtain rod shall be type-304, 1.0 mm stainless steel tubing with satin finish and 25 mm outside diameter. Flanges shall be type-304, 1.0 mm stainless steel with satin finish and drawn, one-piece, seamless construction. Flange shall be 65 mm x 65 mm.

3.4.15 A15, Stainless Steel Shower Curtain Hook

(Bobrick Model 204-1)

Shower curtain hooks shall be 2 mm diameter, type-304 stainless steel. Hooks shall be usable with 25 and 32 mm diameter shower curtain rods. Manufacturer's service and parts manual shall be provided to the building owner/manager upon completion of project. Hooks shall be usable with curtain rod specified in item A14.

3.4.16 A16, Vinyl Shower Curtains

(Bobrick Model 204-3)

Shower curtains shall be opaque, white vinyl, 0.2 mm thick, containing antibacterial and flame-retardant agents, and shall have nickel-plated brass grommets along top. Bottom and sides shall be hemmed. Curtain size shall be 1780 mm wide x 1830 mm high.

3.4.17 A17, Reversible Folding Shower Seat

(Bobrick Model B-5181)

Reversible folding shower seat shall have a frame constructed of type-304, satin-finish stainless steel that consists of 1.6 mm, 30 mm square tubing and 1.2 mm, 25 mm diameter seamless tubing. Seat shall be one-piece, 13 mm thick, solid phenolic with matte-finish, ivory-colored, melamine surfaces, and black phenolic-resin core; secured to frame with stainless steel carriage bolts and acorn nuts. Seat shall be reversible for left- or right-hand installation in the field. Shower seat shall be equipped with two 75 mm diameter mounting flanges constructed of type-304 5 mm thick, satin-finish stainless steel; a guide bracket constructed of type-304, 1.6 mm, satin-finish stainless steel; and a spring constructed of type-301, 0.6 mm stainless steel that is spot-welded to a baseplate of type-304, heavy-gauge stainless steel. Seat shall remain in upright position when not in use. Shower seat shall comply with barrier-free accessibility guidelines (including ADAAG in USA).

3.4.18 A18, Recessed Heavy-Duty Soap Dish with Bar

(Bobrick Model B-439)

Recessed heavy-duty soap dish with bar shall be type-304 stainless steel with matte polished finish. Shell and flange shall be 1.0 mm with drawn and beveled, one-piece with seamless construction. Bar shall be 5 mm thick stainless steel. Unit shall be equipped with a 0.8 mm retaining lip and anchor lugs welded to sides of shell for installation in masonry walls.

3.4.19 NOT USED

3.4.20 A20, Surface-Mounted Utility Hook

(Bobrick Model B-6707)

Surface mounted utility hook shall be type-304 stainless steel with satin finish. Flange and support arm shall be 0.8 mm and equipped with a concealed, 1.6 mm mounting bracket that is secured to a concealed, 1.6 mm wall plate with a stainless steel setscrew. Cap shall be 3.6 mm, welded to the support arm.

3.4.21 A21, Stainless Steel Grab Bars with Snap Flange

(Bobrick Model B-6806)

Grab bar shall be type-304 stainless steel with satin finish. Grab bar shall have 1.2 mm wall thickness and 38 mm outside diameter. Clearance between the grab bar and wall shall be 38 mm. Concealed mounting flanges shall be 3 mm thick stainless steel plate, 50 x 80 mm, and equipped with two screw holes for attachment to wall. Flange covers shall be 0.8 mm, 85 mm diameter x 13 mm deep, and shall snap over mounting flange to conceal mounting screws and/or WingIt fasteners. Ends of grab bar shall pass through concealed mounting flanges and be heliarc welded to form one structural unit. Grab bar shall comply with barrier-free accessibility guidelines (including ADAAG in the USA) for structural strength. Bar lengths to be 915 mm and 1065 mm.

3.4.22 A22, Stainless Steel Grab Bars with Snap Flange

(Bobrick Model B-6861)

Grab bar shall be type-304 stainless steel with satin finish. Grab bar shall have 1.2 mm wall thickness and 38 mm outside diameter. Clearance between the grab bar and wall shall be 38 mm. Concealed mounting flanges shall be 3 mm thick stainless steel plate, 50 x 80 mm, and equipped with two screw holes for attachment to wall. Flange covers shall be 0.8 mm, 85 mm diameter x 13 mm deep, and shall snap over mounting flange to conceal mounting screws and/or WingIt fasteners. Ends of grab bar shall pass through concealed mounting flanges and be heliarc welded to form one structural unit. Grab bar shall comply with barrier-free accessibility guidelines (including ADAAG in the USA) for structural strength.

3.4.23 A23, Lavatory-Mounted Soap Dispenser

(Bobrick Model B-822)

Lavatory-mounted soap dispenser shall dispense liquid and lotion soaps. Valve shall be operable with one hand with less than 22.2N of force to comply with barrier-free accessibility guidelines (including ADAAG in the USA). Piston and spout assembly shall be type-304 stainless steel with bright polished finish. Spout shall rotate 360 deg. without damage to valve mechanism. Escutcheon shall lock to body with concealed locking mechanism that is opened with special key provided. Piston, spout, and supply-tube assembly shall be removable from top for filling and maintenance. Valve shall be equipped with plastic cylinder, stainless steel spring, U-packing seal, and duckbills. Shank shall accommodate mounting thicknesses up to 100 mm. Translucent, shatter-resistant polyethylene container shall have a capacity of 1.0L.

3.4.24 A24, Mirror with Stainless Steel Angle Frame

(Bobrick Model Series B-2909)

Mirror shall have a one-piece stainless steel angle frame, 19 x 19 mm with continuous integral stiffener on all sides and beveled front to hold frame tightly against mirror; corners shall be welded, ground, and polished smooth; all exposed surfaces shall have satin finish with vertical grain. Mirror shall be laminated glass. All edges shall be protected by plastic filler strips. Backs of all glass mirrors shall be protected by full-size, shock-absorbing, water-resistant, nonabrasive, 5 mm thick polyethylene padding. Galvanized steel back shall have integral horizontal hanging brackets located at top for mounting on concealed rectangular wall hanger(s). Mirror shall be secured to wall hanger(s) with concealed Phillips-head locking screws located in bottom of frame.

3.4.25 NOT USED

3.4.26 A28, Surface-Mounted Paper Towel Dispenser and Waste Receptacle

(Bobrick Model B-3909)

Surface-mounted paper towel dispenser and waste receptacle shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Flange shall be drawn and beveled, one-piece, seamless construction. Door shall be secured to cabinet with a full-length stainless steel piano-hinge and equipped with a tumbler lock keyed like other washroom accessories. Paper towel dispenser shall dispense 600 C-fold, 800 multifold, or 1100 singlefold paper towels. Removable waste receptacle shall be secured to cabinet with a tumbler lock keyed like other washroom accessories, have front and side edges of bottom and all top edges hemmed for safe handling, and shall have a minimum capacity of 45.4 L.

3.4.27 A9, Surface-Mounted Multi-Roll Toilet Tissue Dispenser

(Bobrick Model B-2888)

Surface-mounted multi-roll toilet tissue dispenser shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Front of toilet tissue dispenser door shall be drawn, one-piece, seamless construction. Door shall be secured to cabinet with

two rivets and equipped with a tumbler lock keyed like other washroom accessories. Unit shall dispense two standard-core toilet tissue rolls up to 133 mm diameter (1800 sheets). Extra roll shall automatically drop in place when bottom roll is depleted. Unit shall be equipped with two theft-resistant, heavy-duty, one-piece, molded ABS spindles.

-- End of Section --

SECTION 11020A

SECURITY VAULT DOOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-D-00600 (Rev B) Door, Vault, Security

1.2 GENERAL REQUIREMENTS

The vault door unit shall be a steel security-vault type door with frame, day gate, and ramp type threshold, and shall be a standard product of a manufacturer specializing in this type of fabrication.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Vault Door and Frame; G, RE

Manufacturer's catalog data including catalog cuts and brochures. The data shall show that the proposed vault door unit conforms with the requirements in FS AA-D-00600, and has been tested and approved by the General Services Administration (GSA).

SD-07 Certificates

Vault Door and Frame; G, RE

Certification shall state that vault-door units that do not bear the GSA label are constructed to Class 5 standards.

1.4 DELIVERY AND STORAGE

Door and frame assemblies shall be delivered to the jobsite in a protective covering with the brand and name clearly marked thereon. Materials

delivered to the jobsite shall be inspected for damage, and unloaded with a minimum of handling. Storage shall be in a dry location with adequate ventilation, free from dust, water, and other contaminants, and which permits easy access for inspection and handling. Door assemblies shall be stored off the floor on nonabsorptive strips or wood platforms. Damage to doors and frames shall be prevented during handling. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 VAULT DOOR AND FRAME

Design and construction of the door and frame assembly shall conform to FS AA-D-00600. The door shall be Class 5, Type IIR - right opening swing without optical device, Style H - hand change combination lock.

2.2 DAY GATE

The day gate shall be the manufacturer's standard product designed for use with the vault door furnished, and shall provide access control and visual security. The gate shall be hinged on the same side as the vault door, shall swing into the vault, and shall have a locking device operable from outside by key and from inside by knob or handle. Provide 9 bay gate keys.

PART 3 EXECUTION

3.1 INSTALLATION

The vault door assembly shall be installed in strict compliance with the printed instructions and drawings provided by the manufacturer. The day gate shall be installed in a manner that will not interfere with operation of the release handle on the inside of the vault door. After installation, the door, the locking mechanism, and the inner escape device shall be adjusted for proper operation.

-- End of Section --

SECTION 11165

DOCK BUMPERS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bumper

Indicate unit dimensions, method of anchorage, and details of construction.

SD-03 Product Data

Acceptable Manufacturer Products

Manufacturers product listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

Bumper: Durable Corporation
Norwalk, Ohio
800.537.1603
www.durablecorp.com

Bumper: Xtreme Needs
888.436.5683
http://home.rmci.net/xtreme/bumpers/laminate.html

Bumper: Pioneer Manufacturing, Inc
800.251.3382
www.pioneerleveler.com

Bumper Manuf. Product submitted as an "or equal"; G, RE.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

Indicate special installation requirements.

PART 2 PRODUCTS

2.1 COMPONENTS

Dock Bumpers shall be high impact resistant molded or laminated rubber with angle 76.2 mm x 63.5 mm x 6.35 mm thick with 19 mm rods, hot dipped galvanized (ASTM A123).

1. Width: 300 mm.
2. Vertical Height: 300 mm.
3. Length: 450 mm.

Attachment Hardware: 19 mm diameter galvanized bolts and expansion shields.

Touch-Up Primer: Organic zinc paint, minimum 70 percent solids content.

PART 3 EXECUTION

3.1 INSPECTION

Verify that anchor placement is acceptable.

3.2 PREPARATION

Provide integral anchors for placement by Section 03300.

3.3 INSTALLATION

Install dock bumpers in accordance with manufacturer's instructions.

Set plumb and level.

Secure angle end frames to concrete.

-- End of Section --

SECTION 11400A

FOOD SERVICE EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION LABORATORIES (AGAL)

AGAL Directory	(1996) Directory of AGA and CGA Certified Appliances and Accessories

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240/A 240M	(2000) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 269	(2000) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 36/A 36M	(2000a) Carbon Structural Steel
ASTM B 32	(1996) Solder Metal
ASTM D 520	(2000) Zinc Dust Pigment

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code

NFPA 70	(1999) National Electrical Code
NFPA 96	(1998) Ventilation Control and Fire Protection of Commercial Cooking Equipment

NSF INTERNATIONAL (NSF)

NSF 2	(1996) Food Equipment
NSF-01	(1994) Listings of Food Equipment and Related Products, Components, and Materials

UNDERWRITERS LABORATORIES (UL)

UL 197	(1993; Rev thru Jan 2000) Commercial Electric Cooking Appliances
UL 471	(1995; Rev thru Apr 1998) Commercial Refrigerators and Freezers
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 710	(1995; Rev thru Apr 1999) Exhaust Hoods for Commercial Cooking Equipment
UL Elec Equip Dir	(1999) Electrical Appliance and Utilization Equipment Directory

1.2 GENERAL REQUIREMENTS

Food service equipment shall be of the sizes and types shown. Equipment, materials, and fixtures required for use in conjunction with the items to be furnished by the Government shall be furnished and installed by the Contractor. Equipment, materials, and fixtures indicated on the drawings and schedules shown as Contractor furnished and installed, shall be furnished and installed by the Contractor.

1.2.1 Mechanical, Electrical, and Plumbing Work

Plumbing systems, including final connections, shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE. Electrical equipment, motors, wiring, and final connections shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Gas piping and accessories, including final connections, shall be in accordance with Section 15190A GAS PIPING SYSTEMS. Duct work and accessories shall be in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Painting shall be in accordance with Section 09900 PAINTS AND COATINGS. Air-conditioning systems shall be in accordance with Section 15700R UNITARY HEATING AND COOLING EQUIPMENT.

1.2.2 Kitchen Fire Protection Systems

Each exhaust hood system that serves cooking equipment, associated exhaust hood system ducts, and all cooking equipment served by the exhaust hood system shall be protected with a wet chemical fire extinguishing system. The wet chemical fire extinguishing systems shall be in accordance with Section 13965A WET CHEMICAL FIRE EXTINGUISHING SYSTEM. Grease extracting type hoods that have an internal hood fire protection system do not require wet chemical fire extinguishing protection for those components of the exhaust system, and for cooking equipment protected by a UL listed internal hood fire protection system complying to NFPA 96.

1.2.3 National Sanitation Foundation Standards

Food service equipment shall meet the requirements set forth by the National Sanitation Foundation (NSF). Acceptable evidence of meeting the requirements of the applicable NSF standards shall be either the equipment listed in NSF-01 displaying the NSF seal for the year the equipment was manufactured, a certification issued for special or specific food service equipment by NSF under their special one time contract evaluation and certification, or a certified test report from an independent testing laboratory, approved by the Office of the Surgeon General, indicating that the specific food service equipment has been tested and conforms to the applicable NSF standards.

1.2.4 Verification of Dimensions and Coordination of Project Data

The Contractor shall become familiar with all details of the work and shall advise the Contracting Officer of any discrepancy before performing any work. The Contractor shall perform the following:

a. Horizontal and vertical dimensions shall be field verified.

b. Contract drawings and submittal data shall be reviewed for accuracy and completeness.

c. The installed utility capacity and location shall be field checked.

d. Critical systems/components shall be reviewed for application and capacities such as for exhaust hoods, refrigeration systems, fire suppression systems, gas, water, and steam/condensate line sizes and manifold configurations.

e. Delivery shall be coordinated for access through finished openings and vertical handling limitation within the building.

1.2.5 Standard Products

Materials and equipment shall be the standard products of manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience used shall include applications of equipment and materials under similar circumstances and of similar size. When two or more of the same products are supplied they shall be products of one manufacturer. Equipment shall be supported by a service

organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.2.6 Nameplates

Each item of equipment shall bear a stainless steel, aluminum, or engraved polyester nameplate, as standard with the manufacturer, located in a conspicuous position and permanently fastened to the equipment. Name or identification plates shall be of the size standard with the manufacturer for the particular piece of equipment provided. Name plates shall reflect the name of the manufacturer/trade name, serial number, make, and model number, pertinent ratings, operating characteristics, and other information as standard with the manufacturer, date of manufacture, electrical characteristics, and other applicable data, such as flow rate, temperature, pressure, capacity, and material of construction. Separate equipment identification plates with the contract number marked thereon, shall be securely fastened to the surface of each piece of equipment.

1.2.7 American Gas Association Laboratories Standards

Gas-burning equipment shall be designed for operation with the type of gas specified and shall be approved by AGAL. Acceptable evidence of meeting the requirements of the applicable AGAL Directory standards shall be either AGAL mark on equipment, a photostatic copy of the AGAL appliance certificate, a listing of the specific food service equipment or appliance in the AGAL Directory of Certified Appliances and Accessories, or a certified test report from a nationally recognized independent testing laboratory, indicating that the specified equipment has been tested and conforms to the requirements of the applicable AGAL standards.

1.2.8 Underwriters Laboratories Standards

Electrically operated equipment shall be in accordance with applicable UL standards such as UL 471, UL 489, UL 710 and UL 197. Evidence of meeting the requirements shall be a UL label on the equipment, a UL listing mark per UL Elec Equip Dir or a certified test report from a nationally recognized independent testing laboratory indicating that the specific food service equipment has been tested and conforms to the applicable UL standards.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Food Service Equipment; G, RE
Installation; G, RE

Data consisting of a complete list of equipment and materials.

Detail drawings showing complete wiring, piping, and schematic diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearances for maintenance and operation.

a. Detail drawings by Contractor shall be separate drawings and shall be the contractor's standard sheet size, but not smaller than the contract drawings, and indicate the food service equipment and cold storage assemblies with itemized schedule, and special conditions drawings indicating size and location of slab depressions, cores, wall openings, blockouts, ceiling pockets, blocking grounds, ceiling, wall, access panels, and above ceiling hanger assemblies, rough-in plumbing/mechanical systems and rough-in electrical systems.

b. Detail drawings by manufacturer shall be separate drawings; sheet size shall be manufacturer's standard size and indicate item number, name, and quantity, construction details, sections, and elevations, adjacent walls, columns, and equipment, plumbing and electrical schematics, and fabricated fixtures with single electrical or plumbing connection, and service access panels required for maintenance or replacement of mechanical or electrical components.

c. Detail drawings by the Contractor that show the size, type, and location of equipment drain lines, and floor drains. Drawings shall indicate drain lines from equipment, distances of drain lines and floor drain receptacles from equipment and aisles, and elevation views of drain piping and floor drains.

SD-03 Product Data

Food Service Equipment

Manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Brochures shall have front and rear protective covers with labeled project name and include an index indicating item number, quantity, description, and manufacturer, a fly sheet for each component indicating item number, name, quantity, manufacturer, optional equipment, modification, special instruction, and utility requirements, and catalog specifications sheets.

SD-06 Test Reports

Testing

Test reports in booklet format showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Food Service Equipment

Six complete copies of the service manual, not later than 3 months prior to the date of beneficial occupancy, with data for each different item of material and equipment specified. Service manuals shall include:

a. Front and rear protective covers with labeled project name.

b. Index indicating item number, quantity, description, manufacturer's name, and model number.

c. Maintenance instructions for stainless steel and plastic laminate.

d. Manufacturer's catalog specification sheets and manufacturer's detail and control drawings.

e. Manufacturer's operation manual outlining the step-by-step procedures for equipment installation, startup, basic operation features, and operation shutdown.

f. Manufacturer's maintenance manual listing routine maintenance procedures, possible breakdowns, repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed.

g. Manufacturer's list of parts and supplies with current unit price and address of manufacturer's parts supply warehouse.

1.4 DELIVERY AND STORAGE

1.4.1 Delivery

Unless otherwise directed, the following procedures shall apply:

a. Field assembled fixed equipment integrated into structure shall be sent to jobsite when required.

b. Fixed equipment not integrated into structure shall be sent to the jobsite after completion of finished ceilings, lighting, and acidizing of the finished floor and wall systems, including painting.

c. Major movable equipment shall be delivered to inventory in a secured area for interim jobsite storage, or if secured area is not available, when fixed equipment installation/clean-up has been completed.

d. Minor appliances and loose items shall be delivered to the jobsite when the Contracting Officer is prepared to receive and inventory such items.

1.4.2 Storage

Items delivered and placed into storage shall be stored with protection from weather, humidity, and temperature variation, dirt and dust, or other contaminants.

1.4.3 Protection of Fixed/Fabricated Manufactured Equipment

Fiberboard or plywood shall be taped to surfaces as required by equipment shape and installation access requirements.

1.4.4 Prohibited Use of Equipment

Food service equipment shall not be used as tool and material storage, work bench, scaffold, or stacking area.

1.4.5 Damaged Equipment

Contractor shall immediately submit documentation to the Contracting Officer with a recommendation of action for repair or replacement and the impact on project schedule.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following:

2.1.1 Stainless Steel, Nonmagnetic

ASTM A 167 or ASTM A 240/A 240M: 18-8, 300 Series, austenitic, polished to No. 3 or 4 finish on exposed surfaces.

2.1.2 Stainless Steel Pipe and Tubing

ASTM A 269. Pipe and tubing shall be seamless or welded, of the gauge specified, of true roundness, and of material as specified for stainless steel. Seamless tubing shall be thoroughly annealed, pickled, and ground smooth. Welded tubing shall be thoroughly heat-treated, quenched to eliminate carbide precipitation and then drawn true to size and roundness, and ground. Tubing shall be given a No. 3 or 4 finish when exposed to view.

2.1.3 Galvanizing Repair Compound

ASTM D 520, Type I pigment.

2.1.4 Brazing Material

AWS A5.8, class shall be as applicable.

2.1.5 Steel Structural Shapes for Framing

ASTM A 36/A 36M. Structural shapes shall be uniform, ductile in quality,

and shall be free of hard spots, runs, checks, cracks and other surface defects. Sections shall be galvanized by the hot-dip process, conforming to ASTM A 123/A 123M.

2.1.6 Coatings

Coatings shall be of a durable, nontoxic, nondusting, nonflaking, and mildew-resistant type, suitable for use with food service equipment and in conformance with NSF 2. Application shall be in accordance with the recommendations of the manufacturer.

2.1.6.1 Exterior Parts

Exterior, galvanized parts, exposed members of framework, and wrought steel pipe, where specified to be painted, shall be cleaned, and free of foreign matter before applying a rust inhibiting prime and two coats of epoxy-based paint in accordance with Section 09900 PAINTS AND COATINGS, unless otherwise specified. Color shall be selected by the Contracting Officer from manufacturer's standard colors.

2.1.6.2 Solder Material

ASTM B 32, Sn96.

2.2 COUNTERS

Counters shall be constructed in accordance with applicable portions of NSF 2.

2.2.1 Counter Tops

Counter tops shall be constructed of 1.9 mm (14 gauge) stainless steel with all seams and corners welded, ground smooth, and polished.

2.2.2 Cafeteria Counters

Cafeteria counters shall be constructed and sound deadened as indicated and as specified for counters.

2.2.3 Pitch and Drainage of Equipment Surfaces

Wherever a fixture has a waste or drain outlet, the surface shall have a distinct pitch toward such outlet. Corners shall be coved on 19 mm radius and sloped 10 mm per m maintaining level crown at front edges of rolled rims, marine edges, and backsplashes, when tops are sloped to drains.

2.2.4 Drip Gutter

Drip gutter shall be an integral part of the counter top and located below beverage dispensing faucets where indicated. Drip gutter shall be provided with a 25 mm brass drain tube centered in the bottom of the gutter. Bottom shall be pitched to the drain. The drip gutter shall be 100 mm wide, 25 mm deep, and the length indicated. The drip gutter shall be provided with a 100 mm wide, 25 mm high, removable, nonsplash, stainless

steel, wire mesh strainer with frame. A cold water flush inlet fitting shall be installed at one end of the gutter, and shall have a faucet with quick disconnect connection mounted under the top.

2.2.5 Counter Edges and Backsplashes

2.2.5.1 Counter Edges

Counter edges shall be one of the following types:

a. Turned Down: 50 mm at 9O degrees with 19 mm tight hem at bottom. Free Corners shall be rounded on 19 mm radius.

b. Marine Edge: Turned up 13 mm and 38 mm at 45-degree angle and turned down 50 mm at 135 degree angle with 19 mm tight hem at bottom.

c. Rolled Rim: Coved up 75 mm with 38 mm wide rim rolled 180 degrees and turned down to table top; hem edges, and bullnose corners.

2.2.5.2 Counter Backsplash

Counter backsplash shall be one of the following types:

a. Coved up 250 mm and sloped back 38 mm at the top on a 45-degree angle; 63 mm slope where piping occurs. Turned down 25 mm at 135 degrees at the rear of the splash with the ends closed to the bottom of the top turn down. Splash turn down shall be secured to wall with 100 mm long, 1.9 mm (14 gauge) stainless steel "zee" clips anchored to wall, 900 mm on center.

b. Turned up 150 mm at 90 degrees on 16 mm radius with edge turned back 25 mm at 90-degree angle with 25 mm turn down at 90 degrees at rear of splash with the ends closed to the bottom of the top turn down. Splash turn down shall be secured to wall with 100 mm long, 1.9 mm (14 gauge) stainless steel "zee" clips anchored to wall, 900 mm on center.

c. Turned up 150 mm at 90 degrees on a 16 mm radius with edge turned back 50 mm at 90 degree angle with the ends closed to the bottom of the top turn down. Splash turn down shall be secured to wall with 100 mm long, 1.9 mm (14 gauge) stainless steel "zee" clips anchored to wall, 900 mm on center.

2.2.6 Counter Top Support Angles

Counter top support angles shall be of 38 by 38 by 3 mm painted galvanized steel angles with all corners mitered, welded, and ground smooth at perimeter. Cross members shall be provided on 600 mm centers maximum. A 100 by 100 mm, 2.7 mm (12 gauge) stainless steel triangular pad shall be provided where leg gussets are welded to the frame. Angle frame shall be stud bolted to counter top.

2.2.7 Sound Deadening of Counters and Sinks

Counter tops and sinks shall be sound deadened with 13 mm wide rope sealant positioned continuously between all contact surfaces of the frame-members and the underside of counter top, overshelves and undershelves. Stud bolts shall be tightened for maximum compression and the excess sealant trimmed.

2.3 COUNTER BASES

Counter bases shall be open or closed as indicated.

2.3.1 Closed Bases

Closed bases shall be constructed with 38 mm by 38 mm, 3 mm galvanized steel angle with all corners mitered, welded, and ground smooth. Horizontal and vertical angles shall be provided on 600 mm centers or less. The enclosure panels on closed bases shall be of 1.3 mm (18 gauge) stainless steel. Joint trim on enclosed bases shall be 50 mm wide, 1.9 mm (14 gauge) stainless steel, attached with concealed stud bolts and sealed to interior partition. Enclosed bases shall be double walled on interior, exposed ends, and at interior exposed partitions. Service access shall be provided for utilities supplying equipment designed to fit atop the counter.

2.3.2 Open Bases

Open bases shall be constructed of 41 mm outside diameter, 1.6 mm (16 gauge) stainless steel rails welded 360 degrees to the legs.

2.3.3 Gussets

Gussets shall be stainless steel, fully enclosed, a minimum of 75 mm in diameter at the top, reinforced with a bushing, and shall be continuously welded to channel or angle.

2.3.4 Legs

Legs shall be of 1.6 mm (16 gauge), 41 mm outside diameter stainless steel tubing. Legs shall be continuously welded to gussets, channel, or angle as specified.

2.3.5 Feet

Feet shall be sanitary, die-stamped stainless steel bullet-shaped, fully enclosed and shall provide for a 25 mm adjustment without threads being exposed. The bottom of the legs shall be finished off smoothly and the stem overlapped to provide a sanitary closed fitting. Feet for free-standing fixtures requiring utility connections shall be as above except with a flanged plate at the bottom which shall be anchored to the floor with noncorrosive bolts.

2.3.6 Undercounter Shelving

2.3.6.1 Open Base Shelves

Open base shelves shall be constructed of 1.6 mm (16 gauge) stainless steel with all edges turned down 38 mm at 90 degrees with a 19 mm tight hem at bottom. Corners shall be notched a full 90 degrees and welded from underside to completely fill the gap, ground and polished. Undershelf shall be braced with 25 mm by 100 mm, 1.9 mm (14 gauge) stainless steel channel at longitudinal center line and between each intermediate pair of legs.

2.3.6.2 Closed Base Shelves

Interior shelves on closed bases shall be constructed of 1.6 mm (16 gauge) stainless steel. Side edges of the shelf shall be turned up 50 mm at 90 degrees on a 6 mm radius and sealed to the side walls. Rear of the shelf shall be coved up at 90 degrees on a 16 mm radius to shelf above or counter top, flanged out for attachment with no open space at interior. Vertical joints shall be sealed. Front edge shall be turned down 50 mm at 9O degrees with a 19 mm tight hem. The vertical seam of shelf turn down/turn up shall be welded to the face of body partition. Maximum depth of shelves shall be 560 mm. Shelves shall be reinforced with 25 mm by 100 mm, 1.9 mm (14 gauge) stainless steel closed hat channel. Shelf slides, where indicated, shall be 1.9 mm (14 gauge) stainless steel, 38 mm by 38 mm angles, and shall have front and back corners rounded and finished smooth.

2.3.7 Tray Slides

Tray slides shall be solid type. The width of the tray slides shall not be less than 360 mm. The mounting height of the tray slides shall be 850 mm above the finished floor. Tray slides shall be installed true and level. Tray slide shall be designed and installed to preclude tray spillage.

2.3.7.1 Solid Type Slide

Solid type slide shall be constructed of 1.9 mm (14 gauge) stainless steel with the front edge rolled 44 mm at 180 degrees. The top edge of the roll shall be 10 mm above the flat surface of the slide. Two inverted "V" forms, approximately 10 mm high, shall be provided in the flat surface of the slide as the running surface for trays. The back edge of the slide shall be turned up 25 mm at 90 degrees behind counter top turn down. Ends of the slide shall be closed to eliminate sharp edges.

2.3.7.2 Tube Type Slide

Tube type slide shall consist of a minimum of three 25 mm diameter tubes with supporting hardware. The tray slide shall have the ends of each tube closed. The tubes shall be fabricated of stainless steel in the 300 series with a minimum thickness of 1.6 mm (16 gauge).

2.3.8 Protector Shelf

Protector shelf shall be installed on the serving line counters and shall be located over the equipment as indicated. Protector/serving shelf shall be constructed of 1.6 mm (16 gauge) stainless steel, with a minimum width of at least 300 mm, and shall have a full 25 mm skirt with 19 mm tight

hem on all sides and shall be supported on stainless steel uprights, at front. All free corners shall be rounded on a 19 mm radius.

2.3.8.1 Heat Lamps

Heat lamp units shall be provided with consolidated chassis of longest possible length for multiple sections. Heat lamp units shall have integral incandescent display light with warm white lamps and shall be wired to a recess mounted infinitely adjustable heat control with pilot light for each separate section. Heat lamps shall be secured tightly to the underside of the serving shelf and shall have a "USDA" approved heat protector provided between the heat lamps and the shelf. Maximum allowable temperature at the top of a serving shelf shall be 49 degrees C.

2.3.8.2 Fluorescent Display Light Modules

Fluorescent display light modules (not included with heat lamps) shall be in 450 mm and 900 mm increments, each with regular or deluxe white T-8 energy efficient lamps or as indicated on the drawings. Display lamps shall be wired to a single recess mounted master switch per serving shelf.

2.3.8.3 Heat Lamp/Display Wiring

Heat lamp/display wiring shall be concealed in a corner post.

2.3.8.4 Protector Glass

Protector glass sheet shall be no less than 6 mm thick in transparent, tempered plate glass or heat- and mar-resistant clear acrylic framed in an all welded stainless steel channel edging and shall be installed under the protector shelf and in front of the food display. At the top and bottom of the installed glass shall be a 25 mm space for vapor venting. The protector glass or clear acrylic shall be pivoted for easy cleaning. Design shall be such that glass or clear acrylic can be replaced in the event of breakage.

2.3.8.5 Food Shield

Food shield/self serve shall conform to NSF 2 and be constructed of 1.6 mm (16 gauge) stainless steel, with a minimum width of at least 300 mm and shall have a full 25 mm skirt with 19 mm tight hem on all sides and shall be supported on stainless steel uprights at front. All free corners shall be rounded on 19 mm radius.

a. Adjustable louver brackets below the top shall be fitted with 6 mm polished, tempered plate glass or heat and mar-resistant clear acrylic framed in an all welded stainless steel channel and shall be installed with a 175 mm clearance above counter top.

b. Fluorescent light fixtures shall be installed the full length of the none heated undershelf displays. Display light wiring shall be concealed in a corner post. Fixtures shall be prewired to a single recess-mounted master switch per serving shelf.

2.4 DISH COUNTERS

Dish counters shall be constructed and sound deadened as indicated and as specified for counters and sinks. The dish counters shall be fitted and flanged into the dishwashing machine with a water-tight joint.

2.4.1 Dish Counter Support Channels

Dish counter support channels shall be 25 mm by 100 mm by 25 mm, 2.7 mm (12 gauge) stainless steel. Channels shall be provided under dish counter top between each pair of legs and shall have closed ends. Cross members, on the centerline, shall be provided between legs. Channels shall be stud-bolted to counter top at 150 mm on center, maximum.

2.4.2 Dish Counter Components

2.4.2.1 Scupper Drain

Scupper drain shall be provided the full width of dish counter with all corners coved, 150 mm wide by 50 mm deep, and integrally welded to the soiled/clean dish counter top at the entrance/exit of a rack-type dishwash machine. Bottom of the scupper drain shall be scored and sloped to 38 mm brass drain with tailpiece. Removable drainer shall be 1.6 mm (16 gauge) stainless steel, flush-mounted, pan-formed, perforated top, shall have 13 mm holes punched 38 mm on center, and shall be installed in the scupper opening on 13 mm diameter stainless steel legs with closed ends.

2.4.2.2 Prewash Sink

Integral prewash sink shall be 520 mm by 520 mm welded to the dish counter top with the corners rounded on 13 mm radius. The sink bottom shall be pitched to 1.6 mm(16 gauge) stainless steel 38 mm brass drain. Removable rack support/slide assembly shall be a 520 mm square 1.6 mm (16 gauge) gauge frame with two cross members. Two 25 mm by 3 mm stainless steel angle rack guides shall be welded on top of the frame at 500 mm apart with ends flared at 45 degrees.

2.4.2.3 Prerinse Spray

A prerinse spray assembly shall be mounted on the backsplash of the dish counter with vertical tubing, wall bracket, flexible gooseneck hose, and self closing squeeze-type valve and spray.

2.4.2.4 Hose Bib Faucet

A hose bib faucet shall be mounted on a 2.7 mm (12 gauge) stainless steel flange or inverted gusset below top of counter, which shall be ground and polished to match counter top.

2.4.2.5 Undershelves

Undershelves shall be the solid type, and shall be constructed as specified for open base shelves.

2.4.2.6 Scraping Trough

Scraping trough in the soiled dish counter shall be 1.9 mm (14 gauge) stainless steel with all corners 19 mm (3/4 inch) coved, and shall be integrally welded to the dish counter. Trough shall be 200 mm wide minimum and shall be sloped 1 percent (1/8 inch per foot) or from 100 mm depth to integral disposer or prewash sink. Long sides of trough shall be formed on a 60 degree angle with a 13 mm by 13 mm recessed shoulder at juncture of the dish counter. Removable trough covers shall be 197 mm by 500 mm, 1.6 mm (16 gauge) stainless steel, pan formed, and the top shall be perforated (13 mm diameter holes punched 38 mm on center). One trough cover shall be provided for each 900 mm of trough. One inlet fitting shall be installed at the shallow end of the scraping trough, and intermediate inlet fittings shall be installed at 1200 mm on center. Inlet fittings shall be piped to a blending valve, vacuum breaker, solenoid valve, and shall have a globe valve at each intermediate inlet. Integral disposer sink shall be 450 mm by 450 mm by 188 mm deep, 1.9 mm (14 gauge) stainless steel with all corners coved, welded to dish counter/scraping trough and shall be fitted with a removable silverware-trap. Removable flush cover shall be 1.6 mm (16 gauge) stainless steel, 13 mm pan-formed, and perforated (13 mm holes punched at 38 mm on center) with welded corners. A finger ring shall be provided for the removal of the cover. Support clips shall be 6 mm diameter stainless steel rod, 50 mm long, formed at 45 degree angle with two 19 mm leg ends (6 mm long threaded ends). Rod-clips shall be inserted through tight clearance holes in sink corners, and sealed watertight and shall be secured with stainless steel acorn-nuts or tack-welded at exterior of sink wall. Support clips shall be set for a flush cover position (approximately 13 mm below top). A solenoid valve shall be interconnected with the disposer delay-relay control to initiate the blended water flow when the disposer is activated. All inlet fittings shall have 13 mm copper tubing from blending valve to inlet fittings. Exposed fittings shall be chrome plated.

2.4.3 Glass/Cup Rack Overshelf

Glass/cup rack overshelf shall be 1.9 mm (14 gauge) stainless steel with a 38 mm deep "Vee" trough at free long sides with a 25 mm tight hem at inside of trough. A 13 mm marine edge shall be provided at free ends and a 100 mm high splash at the wall.

a. Shelf shall be suspended with bottom edge at 450 mm above counter top.

b. Drain tubes shall be provided at each end of trough through the backsplash to 19 mm above top of table.

c. A horizontal rack rest of 41 mm outside diameter stainless steel tubing shall be provided the full length of the shelf and shall be supported 250 mm above the shelf on 31 mm outside diameter stainless steel tubing spaced at 1500 mm on center.

2.4.4 Dish/Tray Return Shelf

Dish/tray return shelf shall be sized as indicated on the drawings. Shelf

shall extend through opening in wall to be flush with the wall at the deposit side. Shelf shall be turned down 25 mm at 90 degrees at the front with 19 mm return at bottom. Rear long side shall be turned down 25 mm at 90 degrees, and shall be integral with dish counter whenever adjacent.

2.5 NOT USED

2.6 SINKS

Sink shall be of the dimensions indicated and conform to the applicable requirements of NSF 2. Sinks shall be constructed of a minimum of 1.9 mm (14 gauge) stainless steel. Vertical and horizontal corners shall be rounded to a radius of not less than 19 mm with double walls at partitions. Continuous 1.9 mm (14 gauge stainless steel exterior filler panels shall be provided between compartments of multiple-compartment sinks and shall be ground and polished to match the adjacent surfaces. The sink bottom shall be scored and sloped to assure drainage to the waste outlet. Sinks shall be equipped with waste and overflow fittings, drain plugs with quick-opening valves, and faucets of the type specified. Faucet and drain plug, and overflow fitting shall be required for each sink compartment, unless otherwise indicated. Spout outlet of faucets shall be a minimum of 125 mm above the rim of the sink. Sink legs shall be as specified for counters, except that closed gussets shall be welded to the support channels. Sinks installed adjacent to walls or enclosures shall be anchored and sealed thereto. Sinks shall be sound-deadened as specified for counters.

2.6.1 Plumbing/Trim Requirements

2.6.1.1 Drain Plug and Overflow Fittings

Drain shall consist of a 38 mm quick opening brass body valve with side outlet overflow connection with a stainless steel twist lever handle. Removable perforated stainless steel strainer plate shall be not less than 75 mm in diameter. Overflow fittings shall consist of 31 mm diameter chrome-plated brass tubing of not less than 0.91 mm thickness connected to an overflow head in the back of the sink compartment. Overflow head shall have a removable perforated chrome-plated brass or stainless steel strainer plate of not less than 38 mm diameter. Overflow head shall be installed in die-stamped opening 25 mm below counter top.

2.6.1.2 Backsplash-Mounted Faucets

Backsplash-mounted faucets shall be combination fitting-type with an exposed body and concealed supply connections at the back of the sink. Fitting shall have a swinging spout of approximately 200 mm in length and inlets with 19 mm pipe thread. Faucets shall have adjustable flanges. Valves shall have indexed metal lever handles and replaceable seats.

2.6.1.3 Counter Top or Ledge-Mounted Faucets

Counter top or ledge-mounted faucets shall be combination fitting-type with a concealed body and with the supply connections under the sink ledge or counter top. The faucets shall have replaceable valve seats, swinging

spout elevated to clear valve handle, and four-arm or lever-style indexed metal handles. Chrome-plated copper alloy or stainless steel escutcheons for valves and spout, locknuts and washers or lock-nut type escutcheons together with coupling nuts, and 15 mm pipe size union-tailpieces shall be provided.

2.6.1.4 Control Valve Mountings

Gusset-shaped 1.9 mm (14 gauge) stainless steel panel for the control valves shall be mounted on open base fixtures with 88 mm setback from the countertop edge/rim to the valve handle.

2.6.2 Pot Washing Sinks

2.6.2.1 Final Rinse Compartment

The final rinse compartment of the pot washing sink shall be equipped with a booster heater for sanitizing.

2.6.2.2 Temperature Gauge

Temperature gauge shall have a 75 mm diameter face with stainless steel flange.

2.6.2.3 Valves, Temperature Gauge, and Controls Mounting

Valves, temperature gauge, and controls shall be installed in a stainless steel recessed panel, ready for final connections. A perforated stainless steel casing shall be provided over the temperature bulb.

2.6.2.4 False Bottom

False bottom shall be constructed of 1.9 mm (14 gauge) stainless steel, 13 mm deep pan formed with a perforated top (13 mm holes punched 38 mm on center), and shall have welded corners and finger rings. False bottom shall be fitted with 50 mm high by 31 mm outside diameter tubular stainless steel feet with closed ends.

2.6.3 Cutlery and Excess Liquid Sinks

Cutlery and excess liquid sinks shall have a removable standpipe overflow, in lieu of an overflow in the back of the sink. The overflow shall be installed in the corner of the sink compartment. Compartments shall be provided with snug-fitting removable basket strainers. Drain plug with quick-opening valve shall be arranged for operation from the work side of the counter.

2.6.4 Glass Washing Sinks

Backsplashes shall be suitable for mounting the glass washing machine. Back shall be reinforced to eliminate vibration and noise.

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 DRAIN TRENCH LINER/GRATING

Drain trench liner/grating shall be of 1.9 mm (14 gauge) stainless steel in sizes as indicated with a 25 mm wide perimeter shoulder at the top, turned up flush and level with finished floor, tight-hemmed back down to the shoulder level and flanged out 50 mm for attachment to the slab.

2.11.1 Interior of the Liner

Interior of the liner shall be 150 mm deep with corners coved on 19 mm radius; sloped and scored 25 mm to an integrally welded box pattern drain (drain housing only). Drains shall be at 1200 mm on center maximum and shall be fitted with 150 mm long welded tailpiece. A safety chain shall be connected to the basket strainer assembly and the top of the liner wall. Underside of sloping portion of liner shall have 50 mm long "zee" clips.

2.11.2 Aluminum Grating

Aluminum grating shall be removable, without the use of tools, with 38 mm by 5 mm bearing bars and a perimeter frame. Close bearing bars shall have a 33 mm by 100 mm centerline to centerline grid. Section quantities and sizes shall be as indicated on the drawings with a maximum of 600 mm long sections.

2.12 UTILITY DISTRIBUTION SYSTEMS

Utility distribution systems shall be UL listed and conform to NFPA 70. Systems shall be prewired and preplumbed to one final connection point. Systems shall include an electrical distribution assembly and a mechanical manifold assembly as indicated. Systems shall be provided with removable 1.6 mm (16 gauge) stainless steel panels for ease of access. Systems shall be provided with floor mounting pedestals with vertical extensions for overhead service connections.

2.12.1 NOT USED

2.12.2 Mechanical Manifold Assembly

Mechanical manifold assembly shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE and Section 15190A GAS PIPING SYSTEMS. An automatic fuel shut-off device shall be provided in the gas fuel manifold to automatically shut-off the gas supply to any piece of gas-burning equipment in the event of a fire. An automatic fuel shut-off device shall be provided for all cooking equipment served by a single exhaust hood and by adjoining exhaust hood systems. Activation of a shut-off device from one hood system or from adjoining exhaust systems shall not cause the shut down of fuel-fired equipment served by another hood system. The automatic fuel shut-off device shall be the manual-reset type only. The fuel

shut-off device shall be provided with a 5 second delay to eliminate instantaneous power outages. The automatic fuel shut-off and manual fuel shut-off valves shall be mounted at the gas inputs to the utility distribution system. The fuel shut-off device shall be in conformance with NFPA 96.

2.13 ELECTRICAL WORK

Electrical systems, components and accessories shall be certified to be in accordance with NFPA 70 and the following:

2.13.1 Installed Equipment Load

Should the electrical load of the approved equipment differ from that specified or shown on the drawings, the contractor shall provide and install electrical service compatible with the approved equipment.

2.13.2 Electrical Equipment and Components

Food service equipment furnished under this section shall have loads, voltages, and phases compatible with building system, and shall conform to manufacturer standards.

2.13.3 Cords and Caps

Food service equipment cord/caps shall be coordinated with related receptacles. All 120/208/240 volt "plug-in" equipment shall have Type SO or SJO cord and a plug with ground, fastened to frame/body of item. Mobile equipment shall have a strain-relief assembly at the cord connection of the appliance. Mobile electrical support equipment (heated cabinets, dish carts, etc.) and counter appliances mounted on mobile stands (mixers, food cutter, toaster, coffee makers, microwave ovens, etc.) shall have cord/cap assembly with cord-hanger as provided by the manufacturer.

2.13.4 Switches and Controls

Each motor-driven appliance or electrically-heated unit shall be equipped with control switch and overload protection per UL 197 and UL 471. Switches, controls, control transformers, starters, equipment protection and enclosures shall be Industry standards for the equipment environment.

2.13.5 Motors

Motors at 120, 240, 208/240 and 460/480 volts shall have starter with overload protection and short circuit motor protection per manufacturer standards.

2.13.6 Heating Elements

Electrically-heated equipment shall have thermostatic controls. Water heating equipment shall be equipped with a positive low-water shut-off.

2.13.7 Receptacles and Switches

Receptacles which are located in vertical panels of closed base bodies shall be installed in 300 mm by 215 mm by 75 mm deep recessed mounting panel sloped on a 60-degree angle and turned up to the top of the opening. Receptacles which are located in closed base fixtures shall be prewired to a junction box located within 150 mm from the bottom of the utility compartment. Receptacles which are installed in/on fabricated equipment shall be horizontally-mounted in a metal box with a stainless steel cover plate.

2.13.8 Light Fixtures

Light fixtures with lamps which are installed in/on fabricated or field-assembled equipment shall be prewired to a junction box for final connection (fixtures shall be continuous run when indicated). Fluorescent display light shall be installed the full-length of the display stand and serving shelf with stud bolts or as indicated, and shall be prewired through a support post to a recess-mounted switch. Heat lamps shall be installed to underside of serving shelf assemblies as specified. Heat lamp length for chassis shall be sized per manufacturer or as indicated on the drawings. Cold storage light fixtures shall be electrically connected through the hub fitting located on the top of the fixture. Horizontal conduit shall be above the ceiling panels. Plastic sleeves shall be installed through ceiling panels for electrical conduit and the penetrations shall be sealed airtight at both sides of panel.

2.13.9 Final Electrical Connection Provisions

Final electrical connection points of equipment shall be tagged with item number, name of devices on the circuit, total electrical load, voltage, and phase. Fabricated equipment containing electrically-operated components or fittings, indicated on utility connections drawings to be direct-connected, shall have each component, fitting, or group thereof prewired to a junction box for final connection. Refer to the drawings for circuit loading. Field-assembled equipment (example, prefabricated cold storage assemblies, conveyor systems, exhaust hoods) shall have electrical components completely interconnected by this section for final connection as indicated on utility connection drawing. The following groups of cold storage assembly electrical devices shall be prewired to a top-mounted junction box for final connection per compartment grouping, unless otherwise indicated.

a. Light fixtures, switches, and heated pressure-relief vent.

b. Door/jamb heater and temperature monitors/alarms.

c. Evaporator fans, defrost elements, freezer fan door switch, and drain line heaters.

2.13.10 Lamps

Food service equipment containing light fixtures shall have standard appliance type bulbs or energy efficient appliance type bulbs as indicated on the drawings. Exposed fluorescent lamps above or within a food zone shall have plastic coated T-8 energy efficient lamps or standard lamps, sleeved in plastic tube with end caps.

2.13.11 Steam Connection Provisions

Steam-injected equipment shall have a steam inlet globe control valve with cold handle, relief valve, strainer, condensate gate valve, bucket steam trap, and swing check valve. Compartment steam cookers shall have piping manifolded from all compartment exhaust valves to a floor drain, floor sink, or drain trench. Steam generators specified within this section shall have automatic boiler blowdown and a cold water condenser. Separate equipment, devices or components indicated to be connected to a steam-generator, provided under this section, shall be provided with all unions, ells, gate valves, nipples, brackets, clamps, etc., required for the complete operating system for final connection. The steam supply piping shall be insulated with 25 mm fiberglass insulation (48 kg per cubic meter density) and shall have factory-applied fire retardant. A full-length 1.6 mm (16 gauge) stainless steel pipe enclosure with sloping top, jacket, and vapor barrier shall be installed over steam lines.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed at locations shown in accordance with NSF-01 and the manufacturer's written instructions. The Contractor shall make provision for the plumbing, heating, and electrical connections and for equipment indicated as being furnished and installed by the Government.

3.1.1 Equipment Connections

Equipment connections shall be complete for all utilities. Unless otherwise specified, exposed piping shall be chromium-plated copper alloy. Steam operating pressure shall be as indicated.

3.1.2 Backflow Preventers

Backflow preventers shall be furnished as specified in Section 15400A PLUMBING, GENERAL PURPOSE. The Contractor is responsible to install backflow preventers as shown on the contract drawings and at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any source of nonpotable water, or other contaminant. Backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or will be located below the level of the contaminant. Backflow preventers shall be provided of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of waste or other contamination into the potable water system.

3.1.3 Gas Equipment

Installation of equipment shall conform to NFPA 54. A heavy duty steel cable, 75 mm to 150 mm shorter than the equipment connector shall be fastened to the equipment and the walls.

3.1.4 Plumbing Work

Plumbing final connection points of equipment shall be tagged, indicating item number, name of devices or components, and type of utility (water, gas, steam, drain). Extensions of indirect waste fitting shall be provided to open-sight hub drain, floor sink or floor drains from food service equipment.

3.2 CONSTRUCTION OF FABRICATED EQUIPMENT

3.2.1 Grinding, Polishing, and Finishing

Exposed welded joints shall be ground smooth and finished to match the adjoining material. Wherever materials have been depressed or sunken by welding operation, such depressions shall be hammered and peened flush with the adjoining surface, and again ground to eliminate high spots. Ground surfaces shall then be polished or buffed to match adjoining surfaces. Care shall be exercised in the grinding operations to avoid excessive heating of the metal and metal discoloration. Abrasives, wheels, and belts used in grinding shall be free of iron and shall not have been used on carbon steel. In all cases, the grain of rough grinding shall be removed by several successively finer polishing operations. The texture of the final polishing operation shall be uniform, smooth, and consistent. The grain direction of horizontal stainless steel surface shall be longitudinal, including the splash back. Polishing at right angle corners shall provide a mitered appearance. Butt and contact joints shall be close fitting and not require solder as a filler. Wherever brake bends occur, the bends shall be free of open texture or orange peel appearance. Where brake work does mar the uniform appearance of the material, such marks shall be removed by grinding, polishing, and finishing. Sheared edges shall be free of burrs, projections, and fins. Where miters or bullnosed corners occur, such miters and corners shall be finished with the underage of the material and ground to a uniform condition. Overlapping of material is not acceptable. Exposed stainless steel surfaces shall have a No. 3 or 4 finish. Finishes of materials, other than stainless steel, shall be comparable in appearance to commercial mill finish. Exposed surfaces shall include:

a. Exterior surfaces exposed to view.

b. Interior surfaces exposed to view in doorless cabinets.

c. Undersides of shelves shall have a ground finish of No. 90 grit or finer.

3.2.2 Fastening Devices

Fastening devices shall be of the same material as the metal being joined when joint pieces are of similar metal. Fastening devices shall be stainless steel when stainless steel is joined to dissimilar metal. Stud bolts shall be a minimum of M6 stainless steel with length necessary to accept washers, and required nuts, and shall be welded 225 mm on center maximum. Exposed surfaces of equipment shall be free of bolts, screws, and rivet heads. Stainless steel stud bolts shall be used to fasten tops of counters or tables to angle framing and trim to other surfaces. Such bolts

shall be of the concealed type. Threads of stud bolts which are on the inside of fixtures and are either visible or might come in contact with a wiping cloth, shall be capped with chrome plated washers, lock washers, and chromium-plated brass cap nuts. Wherever bolts are welded to the underside of trim or tops, the reverse side of the welds shall be finished uniform with the adjoining surface of the trim or the top. Dimples at these points will not be acceptable.

3.2.3 Welding

3.2.3.1 Welding Rods

Welding shall be done with welding rods of the same composition as the sheets or parts welded.

3.2.3.2 Weld Quality

Welds shall be strong and ductile. Welds shall be free of imperfections such as pits, runs, spatter, cracks, low spots, voids, and shall be finished to have the same color as the adjoining surfaces. Butt welds made by welding straps under seams, or by filling in with solder, or by grinding will not be acceptable. Welded joints shall be homogeneous with the sheet metal. Spot welding shall not be substituted for continuous welding. Joints in tops of counters, tables, drainboards, exposed shelving, and sinks shall be joined by heli-arc welding or a process other than carbon-arc welding or one that will permit carbon pick-up. Joints shall be fully welded. Counter tops shall be factory welded into lengths as long as practical in order to reduce field welded joints to a minimum. Exposed welds shall be ground smooth, flush with adjacent surface and free of burrs and sharp edges. Wherever welds occur on nonfood contact surfaces not suitable for grinding or polishing, such welds and the accompanying discoloration shall be sandblasted and coated in the factory with a nontoxic metallic-base paint. Bolts and screws shall be welded by a process that will minimize the possibility of carbide precipitation. Welds in galvanized steel made after galvanizing, and the adjacent areas where galvanizing is damaged, shall be cleaned and coated with galvanizing repair compound.

3.2.4 Soldering

Soldering shall serve only as a filler to prevent leakage and shall be made with solder material. Stainless steel requiring soldering shall first be cleaned of discoloration and then have a soldering flux applied. Excess or remaining flux and catalytic material shall be removed after the soldering has been completed, and the entire soldered joint and adjacent metallic surfaces shall be cleaned with a liquid alkaline or neutralizing agent to prevent any attack on the surrounding metallic surfaces by the soldering flux.

3.2.5 Brazing

Brazing shall be accomplished with brazing material. Brazing shall be used only on copper tubing to brass and bronze connection fittings.

3.3 TESTING

Equipment shall be inspected and tested under operating conditions after installation. If inspection or test shows defects, such defects shall be corrected, and inspection and test shall be repeated. Refrigerator tests shall include the following:

3.3.1 NOT USED

3.3.2 Operating Tests

An operating test shall be performed on all items after complete installation and adjustment. The failed test item shall be corrected and the test shall be rerun.

3.3.3 Clean and Adjust

Debris resulting from this work, as the installation progresses, shall be removed from the jobsite. All food service equipment, prior to demonstration, shall be cleaned and polished, both interior/exterior. Drawer slides and casters shall be lubricated and adjusted. Pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, and exhaust hood grilles shall be adjusted, as required, for proper operation. Faucet aerators and line strainers shall be cleaned or replaced. Damage to painted finishes shall be touched up.

3.3.4 Equipment Start-Up/Demonstration

The Contractor shall obtain the services of the manufacturer's representative experienced in the installation, adjustment and operation of the equipment specified. The representative shall supervise the start-up, adjustment, and testing of the equipment, prior to the demonstration. Equipment shall be carefully tested, adjusted, and regulated in accordance with the manufacturer's instructions and shall be so certified in writing. A thorough operational demonstration shall be provided of all equipment and instructions furnished for general and specific care and maintenance. Selected items of equipment and attendees shall be scheduled, with the Contracting Officer, at least 2 weeks in advance of demonstration periods.

-- End of Section --

APPENDIX TO 11400 KITCHEN EQUIPEMENT

PART 1 NOT USED
PART 2 EQUIPMENT

ITEM NO.: 1 (1 SET) REQUIRED
ITEM: DISHTABLE, SOILED (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. INTEGRAL STAINLESS STEEL SCRAPPING TROUGH 152 MM WIDE BY 89 MM DEEP AT WATER INLET ENDS AND 127 MM DEEP AT DISPOSAL SINK END. TROUGH TO BE INTEGRALLY WELDED TO DISPOSAL SINK
B. DISPOSAL SINK 508 MM WIDE X 508 MM WIDE X 203 MM DEEP. DISPOSAL (ITEM # 4) COLLAR TO BE WELDED INTEGRALLY TO DISPOSAL SINK
C. HOLE FOR VACUUM BREAKER TO BE MOUNTED THROUGH BACKSPLASH
D. HOLE(S) FOR PRE-RINSE ASSEMBLY (ITEM # 5) THROUGH BACKSPLASH
E. BRACKET FOR DISPOSAL (ITEM #4) CONTROLS

ITEM NO.: 2 (1) REQUIRED
ITEM: SILVER SOAK SINK (OMAR)
MANUFACTURER: PIPER PRODUCTS INC
MODEL NO.: 337-3474

STD FEATURES:

A. LEVER HANDLE DRAIN
B. STAINLESS STEEL

ACCESSORIES:

A. SILVER CHUTE

ITEM NO.: 3 (1) REQUIRED
ITEM: OVERHEAD RACK SHELF, SLANTED (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. APPROXIMATLEY 1575 MM LONG, 535 MM WIDE MINIMUM, TO ACCOMMODATE THREE 508 X 508 MM 20" X 20" DISHWASHER RACKS, WALL MOUNTED

ITEM NO.: 4 (1) REQUIRED
ITEM: GARBAGE DISPOSER (MCAR)
FOR SOILED DISHTABLE
MANUFACTURER: HOBART
MODEL NO.: FD3-300-D-2 (208/60/3)

STD FEATURES:

A. DUAL DIRECTIONAL GRINDING
B. HARDENED AND REPLACEABLE STAINLESS STEEL CUTTER BLOCKS

ACCESSORIES:

A. GROUP D ACCESSORIES, INCLUDES NITRITE RUBBER SILVER-SAVER SPLASH GUARD RING, 178 MM I.D. STAINLESS STEEL WELD-IN ADAPTER FOR SINK, FIXED DIRECTION WATER INLET FOR SINK AND VACUUM BREAKER
B. GROUP 2 ELECTRIC CONTROL INCLUDES MAGNETIC CONTACTORS, PUSHBUTTON START AND STOP AUTOMATIC REVERSING, NEMA 12 ENCLOSURE AND SOLENOID VALVE

ITEM NO.: 5 (3) REQUIRED
ITEM: PRE-RINSE SPRAY ASSEMBLY (MCAR)
MANUFACTURER: T & S BRASS AND BRONZE WORK
MODEL NO.: B-133

STD FEATURES:
A. CENTER BACKSPLASH MOUNTED FAUCET
B. 457 MM RISER
C. SPRAY VALVE
D. FINGER HOOK
E. 863 MM STAINLESS STEEL HOSE LENGTH

ACCESSORIES:
A. WALL BRACKET
B. VACUUM BREAKER

ITEM NO.: 6 (1) REQUIRED
ITEM: CONDENSING HOOD (MCAR)
FOR DISHWASHER ITEM # 7
(SEE MECHANICAL DRAWINGS AND SPECIFICATIONS)
MANUFACTURER: GREENHECK
MODEL NO.: GC

STD FEATURES:
A. REMOVABLE CONDENSATE BAFFLES
B. FULL PERIMETER WELDED GUTTER
C. STAINLESS STEEL DRAIN
D. ALL 1.3 MM STAINLESS STEEL CONSTRUCTION

ACCESSORIES:
A. NONE

ITEM NO.: 7 (1) REQUIRED
ITEM: DISHWASHER (MCAR)
MANUFACTURER: HOBART
MODEL NO.: AM-14

STD FEATURES:
A. ELECTRIC IMMERSION HEAT
B. LED DISPLAYS (FILL, WASH, RINSE) AND TEMPERATURE
C. LOW WATER CONSUMPTION - 4.5 LITERS PER RACK
D. 1 H.P. MAGNETICALLY CONTROLLED MOTOR
E. STAINLESS STEEL
F. STRAIGHT-THROUGH OPERATION WITH THIRD DOOR FOR INSPECTION
G. FEATURES FLEXIBLE TIMING FOR SPECIAL APPLICATIONS

ACCESSORIES:
A. FIVE EACH HEAVY DUTY ALL-PLASTIC PEG COMPARTMENT RACK, 508 MM X 508 MM
B. FIVE EACH HEAVY DUTY ALL-PLASTIC COMBINATION RACK, 508 MM X 508 MM

ITEM NO.: 8 (1) REQUIRED
ITEM: BOOSTER HEATER (MCAR)
FOR DISHWASHER (ITEM #7)
MANUFACTURER: HATCO
MODEL NO.: #C-12

STD FEATURES:
A. "PILOT LIGHT"
B. ON AND OFF SWITCH
C. LOW WATER CUT-OFF
D. HEATING CAPACITY 454 LPH FOR 22 DEGREE C TEMPERATURE RISE
E. 23 LITER STORAGE CAPACITY

ACCESSORIES:
A. ALL STAINLESS STEEL BODY AND BASE
B. 150 TO 200 MM ADJUSTABLE STAINLESS STEEL LEGS

ITEM NO.: 9 (1) REQUIRED
ITEM: OVERHEAD SHELF, FLAT (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. APPROXIMATELY 1070 MM LONG, 535 MM WIDE MINIMUM
B. WALL MOUNTED

ITEM NO.: 10 (1 SET) REQUIRED
ITEM: CLEAN DISHTABLE (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.

ITEM NO.: 11 (2) REQUIRED
ITEM: HAND SINK (MCAR)
(SEE PLUMBING SPECIFICATIONS)
MANUFACTURER:
MODEL NO.:

STD FEATURES:
A. STAINLESS STEEL SINK
B. WRIST ACTION FAUCET

ACCESSORIES:
A. SOAP AND TOWEL DISPENSER WITH MIRROR (SEE TOILET ACCESSORY SECTION)

ITEM NO.: 12 (1) REQUIRED
ITEM: BOOSTER HEATER (MCAR)
FOR 3-COMPARTMENT SINK ITEM # 15

MANUFACTURER: HATCO
MODEL NO.: #C-15

STD FEATURES:

A. "PILOT LIGHT"
B. ON AND OFF SWITCH
C. LOW WATER CUT-OFF
D. HEATING CAPACITY 571.6 LPH FOR 22 DEGREE C TEMPERATURE RISE
E. 23 LITER STORAGE CAPACITY

ACCESSORIES:

A. ALL STAINLESS STEEL BODY AND BASE
B. 150 TO 200 MM ADJUSTABLE STAINLESS STEEL LEGS

ITEM NO.: 13 (1) REQUIRED
ITEM: SANITIZING SINK HEATER (MCAR)
FOR 3-COMPARTMENT SINK ITEM # 15
MANUFACTURER: HATCO
MODEL NO.: 3CS-9

STD FEATURES:

A. ON AND OFF SWITCH WITH INDICATING LIGHT
B. ENERGY CUT-OFF WIRED INTO THE ELECTRICAL CIRCUIT
C. DUAL RESERVOIR SYSTEM
D. SIDE DRAIN
E. SANITIZING TEMPERATURE INDICATOR
F. LOW WATER LIGHT
G. BALANCED 3-PHASE ELECTRICAL POWER

ACCESSORIES:

A. ALL STAINLESS STEEL BODY AND BASE
B. RINSE TEMPERATURE MONITOR

NOTE:

A. MOUNTED UNDER RINSE COMPARTMENT OF 3-COMPARTMENT SINK, ITEM # 15

ITEM NO. 14 (1 SET) REQUIRED
ITEM: CONDENSING HOOD (MCAR)
FOR 3-COMPARTMENT SINK, ITEM # 15
(SEE MECHANICAL DRAWINGS AND SPECIFICATIONS)
MANUFACTURER: GREENHECK
MODEL NO.: GC

STD FEATURES:

A. REMOVABLE CONDENSATE BAFFLES
B. FULL PERIMETER WELDED GUTTER
C. STAINLESS STEEL DRAIN
D. ALL 1.31 MM STAINLESS STEEL CONSTRUCTION

ACCESSORIES:

NONE

ITEM NO. 15 (1 SET) REQUIRED
ITEM: SINK, 3-COMPARTMENT (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. BRACKET FOR DISPOSAL (ITEM #16) CONTROLS
B. DISPOSAL CONE SINK (ACCESSORY WITH ITEM #16) INTEGRALLY WELDED TO DRAINBOARD
C. HOLES FOR PRE-RINSE ASSEMBLY (ITEM # 5) AND VACUUM BREAKER IN BACKSPLASH
D. TWO FAUCETS (SEE PLUMBING SPECIFICATION)
E. DRAIN ASSEMBLY EACH COMPARTMENT
F. HOT TAP FAUCET AT RINSE COMPARTMENT (SEE PLUMBING SPECIFICATION)
G. I.D. PLATE "WARNING 180-DEGREE F WATER" MOUNTED ON BACKSPLASH AT RINSE COMPARTMENT
H. SANITIZING COMPARTMENT SHALL BE PROVIDED WITH TWO 50 MM DIA. FOR SANITIZING SINK HEATER (ITEM #13)

ITEM NO.: 16 (1) REQUIRED
ITEM: GARBAGE DISPOSER (MCAR)
FOR 3-COMPARTMENT SINK ITEM # 15
MANUFACTURER: HOBART
MODEL NO.: FD3-300-B-2 (208/60/3)

STD FEATURES:

A. DUAL DIRECTIONAL GRINDING
B. HARDENED AND REPLACEABLE STAINLESS STEEL CUTTER BLOCKS

ACCESSORIES:

A. CONE SINK 381 MM I.D. WITH HOLE FOR WATER SWIRL INLET
B. GROUP B ACCESSORIES INCLUDES NITRITE RUBBER SILVER-SAVER SPLASH GUARD RING, WATER SWIRL AND VACUUM BREAKER
C. GROUP 2 ELECTRIC CONTROL INCLUDES MAGNETIC CONTACTORS, PUSHBUTTON START AND STOP AUTOMATIC REVERSING, NEMA 12 ENCLOSURE AND SOLENOID VALVE

ITEM NO.: 17 (1) REQUIRED
ITEM: WARMING CABINET (OMAR)
MANUFACTURER: HOBART
MODEL NO.: QSH-1

STD FEATURES:

A. SINGLE TEMPERATURE CONTROL UP TO 180-DEGREE F
B. FORCED AIR HEATER ASSEMBLY
C. SAFETY THERMOSTAT
D. CIRCULATING FAN
E. HUMIDITY CONTROL
F. ALL STAINLESS STEEL CONSTRUCTION

ACCESSORIES:

NONE

ITEM NO.: 18 (1) REQUIRED
ITEM: MIXER (OMAR)
MANUFACTURER: HOBART
MODEL NO.: A-200-DT

STD FEATURES:

A. STAINLESS STEEL BOWL GUARD
B. 1/2 H.P. MOTOR
C. 15-MINUTE TIMER
D. THREE FIXED SPEEDS
E. 20 QUART STAINLESS STEEL BOWL
F. FLAT "B" BEATER
G. "D" WIRE LOOP WHIP
H. 1830 MM CORD AND PLUG

ACCESSORIES:

A. DELUXE FINISH

ITEM NO.: 19 (1) REQUIRED
ITEM: MIXER STAND (OMAR)
FOR MIXER ITEM # 13
MANUFACTURER: PIPER PRODUCTS INC
MODEL NO.: MX-29-TSS

STD FEATURES:

A. STAINLESS STEEL UNDERSHELF
B. STAINLESS STEEL LEGS

ACCESSORIES:

A. MX-52-R STAINLES STEEL ACCESSORY RACK
B. MODIFY STAINLESS STEEL LEG WITH BULLET FEET #331-3429

ITEM NO.: 20 (1) REQUIRED
ITEM: CONVECTION OVEN (MCAR)
MANUFACTURER: VULCAN-HART
MODEL NO.: VC66GD

STD FEATURES:

A. DOUBLE SECTION, DEEP DEPTH GAS CONVECTION OVENS
B. STAINLESS STEEL FRONT AND LEGS
C. ADJUSTABLE FEET
D. INDEPENDENTLY OPERATED STAINLES STEEL 180-DEGREE-SWING DOORS WITH WINDOWS, 2(TWO) PER SECTION
E. 44,000 BTU/H BURNER PER SSECTION; 88,000 BTU/H TOTAL INPUT
F. ELECTRONIC SPARK IGNITERS
G. 1/2 HP TWO SPEED OVEN BLOWER-MOTOR PER SECTION, 115/60/1
H. FRONT, SIDE MOUNTED SOLID STATE TEMPERATURE CONTROLS; RANGE 150 TO 500-DEGREES F

I. 60-MINUTE TIMER WITH AUDIBLE ALRAM
J. AUXILIARY FAN SWITCH FOR RAPID COOL DOWN
K. TWO INTERIOR OVEN LIGHTS PER SECTION
L. COOL TOUCH DOOR HANDLES
M. STAINLESS STEEL OVEN DOOR GASKETS
N. ELEVEN-POSITION NICKEL PLATED RACK GUIDES WITH POSITIVE RACKS TOPS PER OVEN
O. FIVE HEAVY DUTY NICKEL PLATED RACKS PER OVEN
Q. SINGLE 19 MM GAS CONNECTION WITH MANUAL SHUT-OFF VALVE AND REGULATOR

ACCESSORIES:

A. STAINLESS STEEL DRIP PANS
B. STAINLESS STEEL INTERIOR
C. STAINLESS STEEL SIDES AND TOP
D. STAINLESS STEEL REAR BODY ENCLOSURE PANEL

ITEM NO.: 21 (1) REQUIRED
ITEM: RANGE WITH OVEN (MCAR)
MANUFACTURER: VULCAN-HART
MODEL NO.: GH45

STD FEATURES:

A. HEAVY DUTY FOUR BURNER GAS RANGE WITH STANDARD OVEN
B. STAINLESS STEEL FRONT
C. STAINLESS STEEL FRONT TOP LEDGE
D. 152 MM STAINLESS STEEL ADJUSTABLE LEGS WITH BULLET FEET
E. 32 MM DIAMETER FRONT GAS MANIFOLD
F. FOUR 30,000 BTU/H HEAVY CAST TWO PIECE "FLAME RETENTION" BURNERS WITH INDIVIDUAL PILOTS AND CONTROL VALVES
G. HEAVY CAST IRON AERATION PLATES WITH DEEP BOWLS AND REMOVABLE CAST TOP GRATES
H. OVEN CONTROLS LOCATED IN COOL ZONE
I. OVEN IS PORCELAIN ENAMEL ON STEEL HEARTH, DOOR AND SIDE LINERS, 660.4 MM W X 711.2 MM D X 355.6 MM H
J. ONE OVEN RACK
K. TWO RACK POSITIONS
L. 50,000 BTU/H HEAVY CAST "FLAME RETENTION" BURNER WITH ELECTRONIC PILOT IGNITION
M. OVEN TEMPERATURE RANGE: 150 TO 500-DEGREES F

ACCESSORIES:

A. STAINLESS STEEL SIDES
B. 19 MM REAR GAS CONNECTION
C. "BG" SERIES 430 MM HIGH STAINLESS STEEL BACKGUARD

ITEM NO.: 22 (1) REQUIRED
ITEM: STEAM JACKETED KETTLE (MCAR)
MANUFACTURER: CLEVELAND RANGE INC
MODEL NO.: KGT-12-T

STD FEATURES:

A. 45 LITER SELF CONTAINED GAS TILTING KETTLE
B. TEMPERATURE RANGE: 63 TO 127-DEGREE C
C. "SPLASH PROOF" SOLID STATE CONTROL PANEL FOR TEMPERATURE, LOW WATER AND POWER ON/OFF SITCH WITH L.E.D. INDICATORS FOR HEAT CYCLE AND LOW WATER WARNING
D. KETTLE AND ALL EXTERIOR SURFACES STAINLESS STEEL WITH #4 FINISH
E. ENERGY EFFICIENT (65%), HIGH PERFORMANCE GAS-FIRED HEATING SYSTEM FOR FAST HEAT UP AND RECOVERY TIME, 53,000 BTU FIRING RATE AND 34,5000 BTU DIRECTLY APPLIED TO THE PRODUCT
F. GAS PRESSURE REGULATOR
G. SELF LOCKING MARINE-TYPE TILTING MECHANISM WITH BALANCED DESIGN FOR EASY TILTING, TILE HANDLE MOUNTED AT RIGHT, DOUBLE SATETY GAS SHUT OFF TURNS OFF GAS WHEN UNIT IS TILTED
H. LARGE HEAVY DUTY, ROLLED RIM POURING LIP
I. "SPLASH PROOF" RECESSED PRESSURE/VACUUM GAUGE
J. STEAM JACKET PERMANENTLY FILLED WITH TREATED DISTILLED WATER (VENTING AND/OR REFILLING NOT REQUIRED), 50 PSI STEAM JACKET RATING WITH SAFETY VALVE MOUNTED TOWARD THE REAR OF KETTLE
K. AUTOMATIC ELECTRONIC SPARK IGNITION SYSTEM
E. HINGED STAINLESS STEEL DOOR
F. 1830 MM CORD AND PLUG, 5 AMPS

ACCESSORIES:

A. MODEL NUMBER ST-28 EQUIPMENT STAND - ALL STAINLESS STEEL CONSTUCTION WITH REMOVABLE SLIDING COMBINATION DRAIN DRAWER (WITH SPLASH SHIELD) AND PAN SUPPORTS, 31.75 MM SQUARE TUBING, ADJUSTABLE FEET (REAR FEET WITH FLANGE)
B. HOT AND COLD WATER FAUCET (DPK) WITH BRACKET (FBKT)
C. 316 STAINLESS STEEL LINER (316G)
D. LIFT OFF COVER (CL)
E. SELF LOCKING HAND TILT MECHANISM (HTK)
F. KETTLE MARKINGS (KM)

ITEM NO.: 23 (1) REQUIRED
ITEM: BRAISING PAN (MCAR)
MANUFACTURER: VULCAN-HART
MODEL NO.: G40C

STD FEATURES:

A. 152 LITER GAS TILTING BRAISING PAN
B. ONE 30,000 BTU/H BURNER PER EACH 304.8 MM PAN WIDTH, 120,000 BTU/H TOAL INPUT
C. BURNERS SHUT OFF WHEN PAN IS TILTED 5-DEGREES
D. PAN EMPTIES WHEN RAISED TO FULL TILT POSITION
E. PAN BODY 2 MM STAINLESS STEEL, FRONT HINGED, INTERIOR COVED BOTTOM AND CORNERS WITH ETCHED GALLON MARKINGS
F. COOKING SURFACE STAINLESS STEEL BONDED TO 13 MM

THICK CARBON STEEL PLATE
G. FRONT TYPE FORMED POURING LIP FLANGED 102 MM ON BOTH SIDES WITH REMOVABLE POURING LIP STRAINER
H. STATIONARY FOOD PAN RECEIVING SUPPORT MOUNTS UNDER POURING LIP
I. STAINLESS STELL SPRING ASSIST ONE PIECE COVER WITH FULL WIDTH HANDLE AND FULL WIDTH REAR DRIP LIP, LIFT ASSIST WILL HOLD COVER OPEN AT ANY POSITION, CONDENSATE LIP ON COVER TO REDUCE DRIP
J. FULL WIDTH DROP TYPE STAINLESS STEEL BAR HANDLE
K. MANUALLY OPERATED PAN TILTING MECHANISM WITH FOLDING SWING-AWAY HANDLE
L. ELECTRONIC IGNITION SYSTEM FOR AUTOMATIC BURNER LIGHT
M. 60-MINUTE TIMER
N. ON/OFF LIGHTED ROCKER SWITCH
O. RAISING PAN SHUTS OFF HEAT SOURCE
P. 12.7 MM REAR GAS CONNECTION AND GAS PRESSURE REGULATOR
Q. BASED ENCLOSED BY HINGED DOUBLE PAN DOORS AND LIFT OFF PANELS, BOX TYPE CONSTRUCTION
R. 150 MM STAINLESS STEEL 50 MM DIAMETER LEGS WITH STAINLESS STEEL ADJUSTABLE FEET, REAR FEET FLANGED
S. EXPOSED EXTERIOR STAINLESS STEEL EXCEPT FOR REAR
T. CSA DESIGN CERTIFIED, CLASSIFIED BY UL TO NSF STD. # 4

ACCESSORIES:
A. 1830 MM CORD AND PLUG, 120/60/1, 5 AMPS

ITEM NO.: 24 (1) REQUIRED
ITEM: DRAIN TROUGH (MCAR)
(SEE PLUMBING SPECIFICATIONS)
MANUFACTURER:
MODEL NO.:

ITEM NO.: 25 (1) REQUIRED
ITEM: HOOD OVER COOKING AREA (MCAR)
FOR CONVECTION OVEN ITEM # 20,
RANGE W/ OVEN ITEM # 21,
TILTING KETTLE ITEM # 22,
AND BRAISING PAN ITEM # 23
(SEE MECHANICAL DRAWINGS AND SPECIFICATIONS)
MANUFACTURER: GREENHECK
MODEL NO.: GHAW

STD FEATURES:
A. UL LISTED FULL COMPENSATING EXHAUST HOOD WITH AIR CURTAIN SUPPLY
B. UL LISTED VAPORPROOF INCANDESCENT LIGHTS
C. FIRE DAMPER IN SUPPLY DUCT COLLAR
D. FULL LENGTH GREASE TROUGH WITH REMOVABLE GREASE CONTAINER
E. SIZE AS INDICATED

ACCESSORIES:

A. ALL 1.6 MM STAINLESS STEEL CONSTRUCTION
B. STAINLESS STEEL BAFFLE-TYPE REMOVABLE GREASE FILTERS
C. WATER FIRE SUPPRESSION SYSTEM

ITEM NO.: 26 (2) REQUIRED
ITEM: WORK TABLE, MOBILE (OMAR)
MANUFACTURER FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. FOUR 127 MM DIAMETER NON-MARKING, BALL BEARING, STEM-TYPE CASTERS
B. TWO CASTERS WITH LOCKING BRAKES
C. 508 MM X 508 MM X 127 MM DEEP STAINLESS STEEL DRAWER WITH REMOVABLE INSET

ITEM NO.: 27 (1) REQUIRED
ITEM: HOT FOOD WELL (OMAR)
MANUFACTURER: SERVOLIFT/EASTERN STEEL
MODEL NO.: 501-4

STD FEATURES:

A. 900 WATT HEATING SYSTEM FOR EACH FOOD PAN WELL WITH ADJUSTABLE CONTROL THERMOSTAT WITH "OFF" POSITION AND NEON PILOT LIGHT
B. FOUR 127 MM DIAMETER, HEAVY DUTY, DOUBLE BALL BEARING SWIVEL CASTERS WITH NON-MARKING RUBBER TIRES
C. TWO CASTERS WITH BRAKES
D. REMOVABLE 1500 MM CORD AND PLUG SET
E. 250 MM ALUMINUM FRONT AND END APRONS WITH FACTORY BONDED VINYL FABRIC (COLOR SELECTION BELOW)

ACCESSORIES:

A. FOOD PROTECTOR, "CODE FP"
B. FOOD WELLS WITH INDIVIDUAL DRAINS MANIFOLDED TO ONE 20 MM DRAIN VALVE
C. CAM-ACTION LATCHES WITH TRIGGER RELEASE (USED TO JOIN MULTIPLE UNITS TOGETHER)
D. FRONT AND END APRON COLOR - ROYAL BLUE

ITEM NO.: 28 (1) REQUIRED
ITEM: COLD FOOD UNIT (OMAR)
MANUFACTURER: SERVOLIFT/EASTERN STEEL
MODEL NO.: 502-3RCW

STD FEATURES:

A. COLD WALL FOOD UNIT
B. FOUR 127 MM DIAMETER, HEAVY DUTY, DOUBLE BALL BEARING SWIVEL CASTERS WITH NON-MARKING RUBBER TIRES
C. TWO CASTERS WITH BRAKES

D. MECHANICAL REFRIGERATION
E. NEMA 5-15P PLUG WITH 1500 MM THREE-WIRE CORD UL LISTED
F. 13 MM STAINLESS STEEL DRAIN WITH SHUT-OFF VALVE
G. 250 MM ALUMINUM FRONT AND END APRONS WITH FACTORY BONDED VINYL FABRIC (COLOR SELECTION BELOW)

ACCESSORIES:

A. DISPLAY CASE, DOUBLE DECK, "CODE DC" FULL LENGTH X 546 MM HIGH, STAINLESS STEEL UPRIGHTS, AND TOP SHELf, MAR-PROOF HARDENED CLEAR ACRYLIC PLASTIC CENTER SHELF, AND TWO SNEEZE GUARDS.
B. CAM-ACTION LATCHES WITH TRIGGER RELEASE (USED TO JOIN MULTIPLE UNITS TOGETHER)
C. FRONT AND END APRON COLOR - ROYAL BLUE

ITEM NO.: 29 (1) REQUIRED
ITEM: SLICER (OMAR)
MANUFACTURER: HOBART
MODEL NO.: 2712

STD FEATURES:

A. TWO SPEED AUTOMATIC CARRIAGE SLICER WITH FRONT MOUNTED CONTROLS AND REMOVABLE TILTING CARRIAGE SYSTEM
B. TWO SPEED CARRIAGE DRIVE 52 STROKES PER MINUTE FOR HIGH SPEED; 36 STROKES PER MINUTE FOR SLOW SPEED
C. CONTOURED CAST STAINLESS STEEL "STAY SHARP" KNIFE WITH SANITARY HUB
D. ANTIMICROBIAL PRODUCT PROTECTION
E. CAPACITY UP TO 305 MM WIDE OR 190 MM DIAMETER
F. ADJUSTABLE STAINLESS STEEL FENCE
G. LIFETIME GUARANTEED, TOP MOUNTED REMOVABLE AND SUBMERSIBLE BORAZON STONE SHARPENER
H. DOUBLE-ACTION INDEXING CAM
I. PERMANENTLY MOUNTED KNIFE RING GUARD
J. HEAVY GAUGE STAINLESS STEEL TOP COVER WITH INTEGRATED PRODUCT DEFLECTOR
K. LIFT LEVER
L. REMOVABLE REAR DEFLECTOR
M. ELECTROLESS NICKEL PLATED SINGLE SLIDE ROD WITH RESERVOIR WICK
N. STAINLESS STEEEL CARRIAGE, GAUGE PLATE AND KNIFE COVER
O. ERGONOMIC STYLE HANDLE
P. GAUGE PLATE WITH STAINLESS STEEL RIBBED FACE
Q. LOW FENCE
R. SANITARY BURNISHED ALUMINUM BASE
S. NO TOOLS REQUIRED FOR PROPER CLEANING
T. 1/2 HP PERMANENTLY LUBRICATED BALL BEARING KNIFE DRIVE MOTOR, SINGLE PHASE CAPACITOR-START, INDUCTION RUN
U. NYLON CARRIAGE ROLLER
V. HOBART POLY V-BELT KNIFE DRIVE, RUNS AT 400 RPM FOR OPTIMAL PERFORMACE

W. WARRANTY - ALL PARTS AND SERVICE FOR ONE YEAR INCLUDING KNIFE
X. 1800 MM THREE-WIRED CORD AND PLUG

ACCESSORIES:
NONE

ITEM NO.: 30 (1) REQUIRED
ITEM: TABLE, FOOD PREPARATION WITH POT & PAN RACK (OMAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. CANTILEVER 2-BAR STAINLESS STEEL POT RACK
B. POT RACK CONSTRUCTED OF 51 MM X 6 MM STAINLESS STEEL BARS WELDED TO ITS UPRIGHTS
C. POT RACK WITH DOUBLE POINT STAINLESS STEEL SLIDING HOOKS 1 PER APPROXIMATELY EVERY 200 MM
D. POT RACK SUPPORTED BY 41 MM O.D. 1.6 MM THICK STAINLESS STEEL UPRIGHTS
E. UPRIGHTS TO EXTEND THROUGH STAINLESS STEEL GUSSETS AND OPENING IN THE TABLE TOP
F. 508 MM X 508 MM X 127 MM DEEP STAINLESS STEEL DRAWER WITH REMOVABLE INSET
G. STAINLESS STEEL UNDERSHELF

ITEM NO.: 31 (1) REQUIRED
ITEM: CAN OPENER (OMAR)
MANUFACTURER: EDLUND
MODEL NO.: 270

STD FEATURES:
A. REMOVABLE KNIFE AND KNIFE HOLDER (NO TOOLS REQUIRED)
B. GEAR AND SHIELD DESIGNED TO PREVENT SPLASH-BACK FROM ENTERING INTERIOR (REMOVABLE WITHOUT TOOLS)
C. HEAVY DUTY STAINLESS STEEL CONSTRUCTION
D. TWO-SPEED MOTOR
E. HIGH VOLUME CAPACITY
F. WEIGHTED AND BALANCED TO LIFT HEAVIEST # 10 CAN
G. UL LISTED
H. NSF CERTIFIED
I. 120/60/1, 1.2 AMPS

ACCESSORIES:
A. NONE

ITEM NO.: 32 (2) REQUIRED
ITEM: REFRIGERATOR (OMAR)
MANUFACTURER: HOBART

MODEL NO.: QS-2

STD FEATURES:

A. STAINLESS STEEL FRONT HOUSING, ENDS AND DOORS
B. STAINLESS STEEL INTERIOR
C. THREE STEEL PLATED, CLEAR EPOXY COATED WIRE SHELVES PER SECTION
D. EXTERIOR DIGITAL THERMOMETER
E. CONDENSING UNIT ON TOP
F. R134A REFRIGERANT
E. 3000 MM THREE WIRE CORD AND PLUG

ACCESSORIES:

A. 150 MM ADJUSTABLE LEGS WITH STAINLESS STEEL FEET

ITEM NO.: 33 (1) REQUIRED
ITEM: FREEZER (OMAR)
MANUFACTURER: HOBART
MODEL NO.: QSF-1

STD FEATURES:

A. STAINLESS STEEL FRONT HOUSING, ENDS AND DOORS
B. STAINLESS STEEL INTERIOR
C. THREE STEEL PLATED, CLEAR EPOXY COATED WIRE SHELVES PER SECTION
D. EXTERIOR DIGITAL THERMOMETER
E. CONDENSING UNIT ON TOP
F. R404A REFRIGERANT
E. 3000 MM THREE WIRE CORD AND PLUG

ACCESSORIES:

A. 150 MM ADJUSTABLE LEGS WITH STAINLESS STEEL FEET

ITEM NO.: 34 (1) REQUIRED
ITEM: ICE MACHINE (MCAR)
MANUFACTURER: MANITOWOC ICE INC
MODEL NO.: Q-MODEL SERIEC 450, #QD-0452A

STD FEATURES:

A. DICE CUBE SIZE, 173 KGS/24HR
B. AIR COOLED
C. R404A REFRIGERANT
C. 3/4 H.P. COMPRESSOR
D. STAINLESS STEEL FINISH

ACCESSORIES:

A. S-400 STAINLESS STEEL BIN WITH POLYETHYLENE SEAMLESS BIN LINER

ITEM NO.: 35 (3) REQUIRED
ITEM: MOBILE RACK (OMAR)

MANUFACTURER: CRES COR
MODEL NO.: 100-1841C

STD FEATURES:

A. MULTI-PURPOSE STORAGE CABINETS OF NON-CORROSIVE ALUMINUM
B. FULL LENGTH REINFORCED DOOR SWINGS 270-DEGREES
C. CARD CLIP INCLUDED TO LATCH DOOR TO SIDE OF CABINET
D. HOLDS 457 MM X 660 MM PAN ON 38 MM CENTERS
E. HEAVY DUTY 127 MM SWIVEL CASTERS WITH NEOPRENE TIRES; BEARINGS SEALED AND PERMANENTLY LUBRICATED
F. FRONT CASTERS WITH BRAKES

ACCESSORIES:

A. ONE PIECE WRAP AROUND, REINFORCED, NON-MARKING RUBBER BUMPER, ADDS 51 MM TO WIDTH AND DEPTH, MODEL NUMBER 1405-0000

ITEM NO.: 36 (5) REQUIRED
ITEM: SHELVING (OMAR)
MANUFACTURER: SERVOLIFT/EASTERN STEEL
MODEL NO.: SERIES 80-S

STD FEATURES:

A. APPROXIMATE SIZE: 1070 MM L X 460 MM W X 1625 MM H
B. TWO "FREE STANDING" UNITS AND THREE "ADD ON" UNITS REQUIRED
C. ANGLE BEARER CLIPS (USED TO CONNECT MULTIPLE SECTIONS)
D. 1.3 MM STAINLESS STEEL SOLID-STYLE SHELVES, FIVE PER EACH UNIT
E. SHELVES WITH 32 MM HIGH STOP LEDGE ON REAR
F. ADJUSTABLE SANITARY BULLET FEET

ACCESSORIES:

A. 25 MM O.D. STAINLESS STEEL UPRIGHTS WITH TOP CAPS

ITEM NO.: 37 (1 SET) REQUIRED
ITEM: VEGETABLE SINK (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. ONE FAUCET (SEE PLUMBING SPECIFICATION)
B. DRAIN ASSEMBLY EACH COMPARTMENT
C. GOOSE-NECK SPRAY ASSEMBLY WITH WALL BRACE, SEE ITEM # 5

ITEM NO.: 38 (2) REQUIRED
ITEM: TRAY BUSING RACK, DOUBLE (OMAR)
MANUFACTURER: CRES COR
MODEL NO.: 2213-1824 (see Notes)

STD FEATURES:

A. APPROXIMATE SIZE: 1070 MM W X 770 MM D X 1770 MM H

B. TRAY BUSSING RACK OF NON-CORROSIVE ALUMINUM
C. EXTRUDED CHANNELS RIVETED IN PLACE AND SPACED 130 MM ON CENTER
D. CHANNELS DESIGNED TO SECURELY HOLD TRAY TOP AND BOTTOM (TRAY WILL NOT TIP IF HALF WAY OUT OF THE CHANNEL)
E. HEAVY DUTY 127 MM SWIVEL CASTERS WITH NEOPRENE TIRES; BEARINGS SEALED AND PERMANENTLY LUBRICATED
F. FRONT CASTERS WITH BRAKES

ACCESSORIES:

A. SIDE ENCLOSURES
B. BACK ENCLOSURE
C. BOTTOM ENCLOSURE
D. ONE PIECE WRAP AROUND, REINFORCED, NON-MARKING RUBBER BUMPER, ADDS 51 MM TO WIDTH AND DEPTH

NOTES:

A. VERIFY TRAY SIZE WITH CONTRACTING OFFICER BEFORE ORDERING ITEM TO ENSURE CORRECT MODEL NUMBER IS ORDERED
B. ITEM SHALL BE FROM THE SAME MANUFACTURER AS ITEM # 42 DISPENSER, CUP AND GLASS, AND ITEM # 43 DISPENSER, SILVERWARE/TRAY, WITH THE SAME SONSTRUCTION AND STYLING

ITEM NO.: 39 (1) REQUIRED
ITEM: STAINLESS STEEL TRAY SLIDE (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. STAINLESS STEEL SOLID-STYLE TRAY SLIDE
B. TRAY SLIDE SURFACE RIBBED

NOTE:

A. WIDTH INCLUDES WALL/WINDOW SILL THICKNESS

ITEM NO.: 40 (1) REQUIRED
ITEM: COFFEE URN (OMAR)
MANUFACTURER: WILBUR CURTIS COMPANY INC
MODEL NO.: RU-150

STD FEATURES:

A. AUTOMATIC COFFEE URN, SINGLE MODEL 3 GALLON CAPACITY
B. AUTOMATIC REFILL DURING BREWING CYCLE
C. THERMOSTATICALLY CONTROLLED FOR NEAR-INSTANT RECOVERY
D. CLOSED LID BREWING
E. SWING-SPRAY HEAD
F. ELECTRIC OPERATION
G. STAINLESS STEEL FILTER BASKET WITH HOLD-DOWN FLAPS
H. AUTOMATIC AGITATOR/AERATOR
I. MANUAL AGITATOR/AERATOR
J. EMERGENCY REFILL

K. BREWS 13 GALLONS COFFEE PER HOUR
L. UL LISTED
M. NSF APPROVED
N. HOT WATER FAUCET

ACCESSORIES:

A. DOUBLE CHECK VAVLE
B. HALF BREW CYCLE
C. EVERPURE WATER FILTER
D. LOW WATER CUT OFF THERMOSTAT

ITEM NO.: 41 (1) REQUIRED
ITEM: DRINK STAND, W/ DOLLY (MCAR)
MANUFACTURER: FABRICATOR
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.
PROVIDE:

A. STAINLESS STEEL CONSTRUCTION
B. 610 MM (APPROXIMATLY) WIDE DOORS, 1 PAIR, APPROXIMATELY RIGHT 2/3 WIDTH OF UNIT
C. 457 MM (APPROXIMATLY) WIDE DOORS, 1 PAIR, APPROXIMATELY LEFT 1/3 WIDTH OF UNIT
D. FULL LENGTH DRIP TRAY APPROXIMATLY 100 MM W X 100 MM D WITH 25 MM NPT DRAIN
E. OPEN BOTTOM RIGHT 2/3 OF UNIT (BEHIND PAIRED 610 MM WIDE DOORS)
F. CLOSED BOTTOM LEFT 1/3 OF UNIT (BEHIND PAIRED 457 MM WIDE DOOR) WITH INTERMEDIATE SHELF
G. ONE EACH 254 MM WIDE BY 127 MM HIGH CUTOUT IN BACK OF STAND (FOR ACCESS TO ELECTRICAL OUTLET AND PLUMBING CONNECTIONS)
H. ONE EACH STAINLESS STEEL DOLLY MINIMUM OF 660 MM WIDE X 660 MM DEEP X 381 MM HIGH (TO ACCOMMODATE FIVE SYRUP TANKS) WITH FOUR 50 MM MINIMUM DIAMETER NON-MARRING CASTERS
I. FULL-LENGTH SOLID RIBBED TRAY SLIDE 33 MM WIDE
J. TWO EACH 9.5 MM GROMMETED HOLES FOR WATER LINES CONNECTED TO COFFEE URN (ITEM # 40) AND SODA IDSPENSER (NIC)
K. TWO GALVANIZED EYELETS RATED FOR 68 Kg WITH 25 MM I.D. LOCATED INSIDE UNIT IN FRONT LEFT CORNER LOCATED TO ACCOMMODATE CHAIN FOR SECURING CO2 TANK

NOTE:

A. ELECTRIC OUTLET ON WALL ABOVE STAND FOR COFFEE MAKER ITEM # 43
B. ELECTRIC OUTLET ON WALL BELOW COUNTER TOP AT BACK OF STAND FOR SODA DISPENSER (NIC)
C. HOSE BIB ON WALL BELOW COUNTER TOP AT BACK OF STAND FOR WATER CONNECTIONS TO COFFEE URN #43 AND SODA DISPENSER (NIC)

ITEM NO.: 42 (3) REQUIRED
ITEM: DISPENSER, CUP AND GLASS (OMAR)
MANUFACTURER: SERVOLIFT
MODEL NO.: CCA-ST-20 X 20

STD FEATURES:

A. CANTILEVER STYLE MOBILE CUP AND GLASS DISPENSER, 584 MM W X 787 MM D X 940 MM H
B. SELF-LEVELING SUSPENSION SYSTEM DISPENSING MECHANISM CONSISTING OF STAINLESS STEEL AIRCRAFT CABLE, PLATED STEEL PULLEYS WITH SHIELDED, GREASE PACKED BALL BEARING (NO LUBRICATION REQUIRED) AND TEMPERED CHROME VANADIUM COIL SPRINGS
C. APPROXIMATE CAPACITY: UP TO 192 GLASSES OR 175 CUPS
D. STAINLESS STEEL TUBULAR PUSH HANDLE
E. FRAME IS ALL-WELDED HEAVY GAUGE STEEL FINISHED WITH GRAY BAKED ENAMEL OVER RUST-RESISTING UNDERCOAT; MOUNTED ON 1.2 MM STAINLESS STEEL "Z" SECTION BASE
F. BODY IS 2 MM STAINLESS STEEL ON ALL SIDES
G. RACK CARRIER IS ALL-WELDED 1.6 MM STAINLESS STEEL

ACCESSORIES:

A. HEAVY DUTY 127 MM SWIVEL DOUBLE BALL BEARING CASTERS WITH NON-MARKING RUBBER TIRES
B. BACK TWO CASTERS WITH BRAKES
C. ONE PIECE WRAP AROUND, REINFORCED, NON-MARKING RUBBER BUMPER, ADDS 51 MM TO WIDTH AND DEPTH
D. FOR 508 MM X 508 MM SIZE DISHWASHER RACKS

NOTES:

A. VERIFY DISHWASHER RACK SIZE WITH CONTRACTING OFFICER BEFORE ORDERING ITEM TO ENSURE CORRECT MODEL NUMBER IS ORDERED, ESPECIALLY IF THE CONTRACTOR SUBSTITUTES A DIFFERENT MANUFACTURER/MODEL NUMBER DISHWASHER (ITEM # 7) THAN THE MANUFACTURER/MODEL NUMBER LISTED
B. ITEM SHALL BE FROM THE SAME MANUFACTURER AS ITEM # 38 TRAY BUSING RACK, DOUBLE, AND ITEM # 43, DISPENSER, SILVERWARE/TRAY, WITH THE SAME CONSTRUCTION AND STYLING.
C. EIGHT NYLON SILVERWARE CYLINDERS

ITEM NO.: 43 (2) REQUIRED
ITEM: DISPENSER, SILVERWARE/TRAY (OMAR)
MANUFACTURER: SERVOLIFT
MODEL NO.: TCA-ST-OSW8, TRAY SIZE 356 X 457 MM

STD FEATURES:

A. 1295 MM H FOR TRAY SIZE 356 X 457 MM
B. TOP MOUNTED STAINLESS STEEL SLOPED OVERHEAD-TYPE SILVERWARE DISPENSER, ENCLOSED ON ALL FOUR SIDES WITH EIGHT OPENINGS FOR ROUND SILVERWARE CYLINDERS
C. SELF-LEVELING SUSPENSION SYSTEM DISPENSING MECHANISM CONSISTING OF STAINLESS STEEL AIRCRAFT CABLE, PLATED STEEL PULLEYS WITH SHIELDED, GREASE PACKED BALL BEARING (NO LUBRICATION REQUIRED) AND TEMPERED CHROME VANADIUM COIL

SPRINGS
D. APPROXIMATE CAPACITY: 100 TO 150 TRAYS, 35 TO 40 PIECES OF SILVERWARE PER CYLINDER
E. FRAME IS ALL-WELDED HEAVY GAUGE STEEL FINISHED WITH GRAY BAKED ENAMEL OVER RUST-RESISTING UNDERCOAT; MOUNTED ON 1.2 MM STAINLESS STEEL "Z" SECTION BASE
F. BODY IS 2 MM STAINLESS STEEL ON ALL SIDES
G. TRAY CARRIER IS ALL-WELDED 1.6 MM STAINLESS STEEL

ACCESSORIES:
A. HEAVY DUTY 127 MM SWIVEL DOUBLE BALL BEARING CASTERS WITH NON-MARKING RUBBER TIRES
B. BACK TWO CASTERS WITH BRAKES
C. ONE PIECE WRAP AROUND, REINFORCED, NON-MARKING RUBBER BUMPER, ADDS 51 MM TO WIDTH AND DEPTH
D. EIGHT NYLON SILVERWARE CYLINDERS

NOTES:
A. VERIFY TRAY SIZE WITH CONTRACTING OFFICER BEFORE ORDERING ITEM TO ENSURE CORRECT MODEL NUMBER IS ORDERED
B. ITEM SHALL BE FROM THE SAME MANUFACTURER AS ITEM # 26 TRAY BUSING RACK, DOUBLE, AND ITEM # 42, DISPENSER, CUP AND GLASS, WITH THE SAME CONSTRUCTION AND STYLING.

DESIGNER NOTE: Actual model number to be ordered shall be coordinated with Contracting Officer based on tray size selected by user. Designer will need to fill in the blanks for STD FEATURES "A" if different size tray is to be used.

ITEM NO.: 44 (3) REQUIRED
ITEM: AIR CURTAIN (MCAR)
MANUFACTURER: MARS
MODEL NO.: 42C

STD FEATURES:
A. WALL MOUNTED CONTROL PANEL FOR ONE (1) MOTOR, MOUNTED ON WALL RIGHT OF DOOR
B. WHITE FINISH

ACCESSORIES:
NONE

ITEM NO.: 45 (1) REQUIRED
ITEM: MAKE-UP AIR UNIT (KMAU-1) (MCAR)
AND KITCHEN FAN (KF-1)
FOR HOOD ITEM # 25
(SEE MECHANICAL DRAWINGS AND SPECIFICATIONS)
MANUFACTURER: GREENHECK
MODEL NO.: KSU ARRANGEMENT A

STD FEATURES:
A. AS INDICATED AND SPECIFIED * (SEE MECHANICAL DRAWINGS AND

SPECIFICATIONS)

ACCESSORIES:
A. AS INDICATED AND SPECIFIED * (SEE MECHANICAL DRAWINGS AND SPECIFICATIONS)

ITEM NO.: 46 (1) REQUIRED
ITEM: CAN WASH (MCAR)
(SEE CIVIL AND PLUMBING DRAWINGS)
MANUFACTURER:
MODEL NO.: CUSTOM - SIZE AND SHAPE AS INDICATED AND SPECIFIED.

PART 3 NOT USED

-- End of Section --

SECTION 11401N

ELECTRIC KITCHEN EQUIPMENT (OMAR FUNDED)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 250	(1993; R 1998) Household Refrigerators and Freezers
UL 923	(1995; R 1998) Microwave Cooking Appliances

1.2 RELATED REQUIREMENTS

Section 15050N, "Basic Mechanical Materials and Methods," applies to this section, with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Kitchen equipment; G, RE

SD-08 Manufacturer's Instructions

Kitchen equipment

SD-10 Operation and Maintenance Data

Kitchen equipment, Data Package 2

Submit operation and maintenance data.

PART 2 PRODUCTS

2.1 KITCHEN EQUIPMENT

2.1.1 Materials

Except as modified herein, provide manufacturer's standard materials for kitchen equipment. Provide quantities, physical dimensions, colors, and electrical characteristics as indicated.

2.1.2 Refrigerator

UL 250, refrigerator with frostproof top freezer, minimum 0.54 cubic meter, automatic defrosting, two vegetable bottom baskets, four adjustable shelves, two door shelves and minimum 12 egg container in the door, separate interior shelves, multiple door shelves, and door mounted ice and water dispenser. For refrigerator with top freezer, provide reversible (left swing and right swing interchangeable) doors. Provide four fixed rollers or adjustable leg levelers. Color shall be white.

Refrigerator shall be equal to GE Model PTC22MFMRWW.

2.1.3 Microwave Oven

UL 923, with black glass window door, minimum 0.0452 cu m capacity, automatic oven light, browning element, 10 power levels, automatic temperature controllers, minimum two automatic memory levels, digital time controllers, and electronic touch-control panel. Color shall be white.

Microwave shall be equal to GE Model JE1640 WB.

PART 3 EXECUTION

3.1 INSTALLATION

Install kitchen equipment in accordance with manufacturers' instructions and NFPA 70.

3.2 FIELD QUALITY CONTROL

Conduct inspection and testing in the presence of the Contracting Officer.

3.2.1 Field Inspection

Before and after installation, inspect each piece of kitchen equipment for compliance with specified requirements.

3.2.2 Operation Tests

Upon completion, but before final acceptance, perform operation tests on each piece of equipment to determine that components, including controls, safety devices, and attachments, operate properly and in accordance with specified requirements.

-- End of Section --

SECTION 12320A

CABINETS AND COUNTERTOPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(1994) Cabinet Hardware

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA A161.1	(1995) Performance & Construction Standards for Kitchen and Vanity Cabinets

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates

1.2 DESIGN

Cabinets shall be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Cabinets shall be constructed as specified and shall meet the requirements of KCMA A161.1. Wall and base cabinet assemblies shall consist of individual units joined into continuous sections. Fastenings shall be accomplished to permit removal and replacement of individual units without affecting the remainder of the installation. Counters shall be provided with watertight sink rim when indicated. Drawers shall be removable and shall be equipped with position stops to avoid accidental complete withdrawals. Shelves shall be fixed or adjustable as indicated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G, RE

Drawings showing each type of cabinet and related item, and clearly indicating the complete plan, location, and elevations of the cabinets and accessories and pertinent details of construction, fabrication, and attachments.

SD-03 Product Data

Cabinets
Countertops and Backsplash

Manufacturer's printed data, catalog cuts, installation and cleaning instructions.

SD-04 Samples

Cabinets; G, RE
Countertops and Backsplash; G, RE

In lieu of individual samples, complete minimum size cabinets may be furnished as samples. Mock-up units are not acceptable. Samples shall be of sufficient size to show color, pattern, and method of assembly.

a. Countertop and backsplash - One section, containing both.

b. Door and drawer front - One of each, with hardware mounted.

c. Countertop color samples approximately 50 x 75 mm size.

d. Stain/color samples approximately 50 x 75 mm size.

SD-06 Test Reports

Cabinets and Countertops

Test reports certifying that all cabinets comply with the requirements of KCMA A161.1. Tests shall be conducted by independent laboratories approved by KCMA. KCMA certification seals affixed to the cabinets will be accepted in lieu of certified test reports.

1.4 DELIVERY AND STORAGE

Cabinets shall be delivered to the jobsite wrapped in a protective covering. Cabinets shall be stored in accordance with manufacturer's recommendations in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access for inspection and handling. Cabinets shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 CABINETS

Wall and base cabinets shall be of the same construction and same outside appearance. Door design shall be solid flush face from vendors standard styles. Corner cabinets shall be equipped with notched shelving as indicated. Shelves shall be fixed or fully adjustable as indicated. Adjustable shelves shall be capable of adjusting on approximately 75 mm increments. Shelves shall be supported by self-locking clips or wood dowels. Dowels shall be approximately 8 mm in diameter by 40 mm long. Dowels shall be inserted into borings for the shelf adjustments. Shelves shall be minimum 13 mm thick plywood or minimum 13 mm thick high-density thick 20 kg density particle board. Drawer fronts shall be 20 mm thick, high-density particle board core.

2.1.1 Frame Type Cabinets

The cabinets shall be constructed with frame fronts and solid ends, or frame construction throughout. Frame members shall be 20 mm thick by 38 mm wide; kiln-dried hardwood, glued together, and shall be either mortised and tenoned, dovetailed or doweled, nailed, stapled or screwed. Top and bottom corners shall be braced with either hardwood blocks that are glued together with water resistant glue and nailed in place, or metal or plastic corner braces. Backs of wall cabinets shall be 3 mm thick plywood, tempered hardboard or 9 mm thick, high-density particle board. Backs of base and wall cabinets shall be 9 mm thick hardwood or 9 mm thick, high-density particle board. Bottoms of cabinets shall be minimum 9 mm thick plywood, 9 mm high-density particle board or sound grade plywood and shall be braced with wood members glued in place. Cabinet ends shall be 16 mm thick hardwood plywood.

2.2 COUNTERTOPS AND BACKSPLASH

2.2.1 High-Pressure Laminated Plastic Clad Countertops

Clad countertop and backsplash shall be constructed of 19 mm thick, high-density particle board core and shall be post formed cove type. Cove type shall be a single unit with self-edging and plastic laminate coved at the juncture of the countertop and backsplash. Backsplash shall be not less than 90 mm high. Edging and trim shall consist of plastic laminate cut and fitted to all exposed edges. End splashes constructed of 19 mm plywood or 19 mm thick, high-density particle board core shall be supplied. Continuous sheets of longest lengths practicable shall be provided. Joints in surface sheeting shall be tight and flush and held to a practicable minimum. When the countertop and backsplash are two separate units, GP50 plastic laminate shall be used. When the countertop and backsplash are one unit, PF42 plastic laminate shall be used. Plastic laminate shall conform to the requirements of NEMA LD 3 and plastic laminate adhesive shall be contact type applied to both surfaces. For fully formed and cove type countertops, the post-forming plastic laminate shall not be bent to a radius smaller than the limit recommended by the plastic manufacturer.

2.3 NOT USED

2.4 FINISH

2.4.1 Cabinet Finish

Cabinets shall be provided with a factory-applied durable finish in accordance with KCMA A161.1 requirements and of a type standard with the manufacturer. Natural finish wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides shall be fabricated of wood which will be free of extreme color variations within each panel or between adjacent panels. Exposed exterior surfaces shall be plastic laminate. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

2.4.2 NOT USED

2.4.3 Backer Sheets

Backer Sheets of high pressure plastic laminate, shall conform to NEMA LD 3, Grade BK20 and shall be applied to the underside of all core material.

2.5 HARDWARE

Hardware shall conform to BHMA A156.9, shall be suitable for kitchen cabinet use, and shall include all miscellaneous hardware for a complete installation. Door hinges shall be self-closing type. Drawer runners shall have nylon rollers standard with the manufacturer. Hardware and fastenings for doors and drawers with particle board cores shall be of the through-bolt type. The types and finishes of hardware shall be as follows:

BHMA DESIGNATION

TYPE	NUMBER	FINISH
Pulls	B02012	652
Slide	B05091	652
Framless Concealed Hinges	B01602	652

2.6 COLOR, TEXTURE, AND PATTERN

Design, color, and finish shall be as specified in Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Cabinets shall be installed level, plumb, and true to line, and shall be attached to the walls or floors with suitable devices to securely anchor each unit. Countertops, accessories, and hardware shall be installed as indicated on the drawings. Installation shall be in accordance with the manufacturer's approved printed instructions. The inner edge of sink cut-outs in laminated plastic tops shall be painted with a coat of semigloss enamel paint and sink flanges shall be set in a bed of sealant. Closer and filler strips and finish moldings shall be provided as required.

Prior to final acceptance, doors shall be aligned, and hardware shall be adjusted.

3.2 CLEANING

Cabinet and countertop surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

SECTION 12350A

CASEWORK FOR MEDICAL AND DENTAL FACILITIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(1998) Elastomeric Joint Sealants

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-C-2929	(Basic) Casework, Metal and Wood (Medical and Dental) (Inch Pound)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, RE

Drawings showing each type of cabinet and related item. The drawings shall clearly indicate the complete plan and elevations of the cabinets and accessories and pertinent details of construction, fabrication, and attachments.

SD-03 Product Data

Casework; G, RE

Manufacturer's printed data, catalog cuts, and instructions for installation and cleaning.

SD-04 Samples

Casework; G, RE

In lieu of individual samples, complete minimum size casework

may be furnished as samples. Mock-up units are not acceptable. Samples shall be of sufficient size to show color, pattern, and method of assembly.

a. Countertop and backsplash - One section, containing both.

b. Door and drawer front - One of each, with hardware mounted.

c. Melamine plastic color samples approximately 50 x 75 mm size.

d. Stain/color samples shall be approximately 50 x 75 mm size.

SD-07 Certificates

Casework

Certificates attesting that the casework meets the requirements specified.

1.3 DELIVERY AND STORAGE

Casework shall be delivered to the jobsite wrapped in a protective covering. Casework shall be stored in an adequately ventilated, dry location that is free of dust, water, or other contaminates and in a manner to permit access for inspection and handling. Casework shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 CASEWORK

Casework shall be as scheduled on the approved detail drawings. The casework shall be factory fabricated of manufacturer's standard sizes and finishes and shall conform to FS AA-C-2929 and the requirements specified below. Material finish and color shall be in accordance with Section 09915 COLOR SCHEDULE and be from manufacturers standard line.

2.1.1 Medical Casework

Medical casework shall be baked enamel carbon steel.

2.1.2 Dental Casework

Dental operator casework shall be baked enamel carbon steel.

2.1.3 Counter tops

Counter tops shall be plastic laminate covered plywood.

PART 3 EXECUTION

3.1 INSTALLATION

Casework shall be located as indicated. The installation of the casework shall not damage the work of other trades. The casework shall be secured in place in true alignment, level, and plumb. Units shall be secured with screws through backs to cleats that have been anchored to building structure with toggle or expansion bolts. Wall-hung cabinets shall be installed to support the weight of the cabinets plus the normally expected weight of the contents of the cabinets. Fasteners shall be spaced 300 mm on center using at least three bolts in each 900 mm or 1200 mm unit width. Adjoining cabinets in an assembly shall be joined together at top and bottom with inconspicuous bolts or clips. Cabinets shall be bolted to bases at cabinet corners. Metal bases shall be faced with resilient material similar to the base provided for the space adjacent to the cabinets. Where base cabinets and counters are removable, wall anchors shall be readily accessible. Joints between the casework and wall surfaces which are not larger than the joints between casework sections shall be sealed flush with sealant conforming to ASTM C 920, Type M, Grade NS, Class 25, Use NT. Larger joints shall be closed with filler strips of the same material and finish as adjacent casework. Filler strips shall be cut to the contour of the wall surface and secured to the casework with concealed nails or screws. Width of filler strips shall not exceed 150 mm in width. Metal cabinets in rooms having terrazzo or ceramic-tile floors shall be set on concrete or masonry bases with exposed faces finished the same as other bases in the room. Height of counter tops shall be as indicated on the drawings. Where required, toe space at front of cabinets shall be provided by installing front face of cabinets 75 mm in front of face of base. Where toe space is not required, face of base and cabinets shall be flush. Bases shall have a height of approximately 100 mm. All items shall be installed as required for proper operation in accordance with the manufacturer's directions.

3.2 CLEANING

Cabinets and countertops shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

SECTION 12490A

WINDOW TREATMENT

PART 1 WORK DESCRIPTION

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-V-00200 (Rev B) Venetian Blinds

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, RE

Drawings showing fabrication and installation details. Drawings shall show layout and locations of track, direction of draw, mounting heights, and details.

SD-03 Product Data

Window Treatments; G, RE
Hardware; G, RE

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Treatments; G, RE

Three samples of each type and color of window treatment. Blind slats or louvers shall be 150 mm in length for each color. Track shall be 150 mm in length. Shade material shall be minimum 150 x 150 mm in size.

1.3 GENERAL

Window treatment shall be provided, complete with necessary brackets, fittings, and hardware. Each window treatment type shall be a complete unit provided in accordance with paragraph WINDOW TREATMENT PLACEMENT SCHEDULE. Equipment shall be mounted and operated as indicated. Windows to receive a treatment shall be completely covered. The Contractor shall take measurements at the building and shall be responsible for the proper fitting and hanging of the equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling. Materials shall be stored flat in a clean dry area with temperature maintained above 10 degrees C.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Each blind, including hardware, accessory items, mounting brackets and fastenings, shall be provided as a complete unit produced by one manufacturer. All parts shall be one color unless otherwise shown, and match the color of the blind slat. Steel features shall be treated for corrosion resistance.

2.1.1 Horizontal Blinds

Horizontal blinds shall conform to FS AA-V-00200, Type I (50 mm slats), except as modified below. Blind units shall be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds shall be inside mount as shown.

2.1.1.1 Head Channel and Slats

Head channel shall be steel or aluminum nominal 0.46 mm for Type I. Slats shall be aluminum, not less than 0.203 mm thick, and of sufficient strength to prevent sag or bow in the finished blind. A sufficient amount of slats shall be provided to assure proper control, uniform spacing, and adequate overlap.

2.1.1.2 Controls

The slats shall be tilted by a transparent tilting wand, hung vertically by its own weight, and shall swivel for easy operation. The tilter control shall be of enclosed construction. Moving parts and mechanical drive shall be made of compatible materials which do not require lubrication during normal expected life. The tilter shall tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. A mechanism shall be included to prevent over tightening. The wand shall be of sufficient length to reach to within 1500 mm of the floor.

2.1.1.3 Intermediate Brackets

Intermediate brackets shall be provided for installation of blinds over 1200 mm wide and shall be installed as recommended by the manufacturer.

2.1.1.4 Hold-Down Brackets

Universal type hold-down brackets for sill or jamb mount shall be provided.

2.1.2 Vertical Blinds

Vertical blind units shall be capable of nominally 180 degree partial tilting operation and full stackback. The blinds shall be listed by the manufacturer as designed for heavy duty strength applications including heavy duty hardware. Vertical blinds shall be wall mounted with inside brackets as shown. Blinds shall be sill length.

2.1.2.1 Louvers

Solid vinyl louvers shall be fire resistant, UV stable, impact resistant, and shall not emit corrosive fumes in a fire. Louvers shall hang without a bottom chain. 89 mm (3-1/2 inch) louvers shall overlap not less than 10 mm and shall be dimensionally stable.

2.1.2.2 Carriers

Carriers shall be provided to support each louver. Carriers shall be of molded plastic and shall transverse on self-fabricated wheels for smooth, easy operation. The hook of the carrier shall have an automatic latch to permit easy installation and removing of the louver, and shall securely lock the louver for tilting and traversing.

2.1.2.3 Headrail System

Headrail system shall be not less than 1.19 mm thickness and shall be made of anodized aluminum alloy or 0.635 mm thick phosphate treated steel with a baked on ivory gloss enamel paint finish. The headrail shall extend the full width of the blind and each end shall be closed with an end cap. One cap shall contain the traversing and tilting controls. The opposite cap shall house the pulley for the traversing cord.

2.1.2.4 NOT USED

2.1.2.5 Controls

Tilting control and traversing controls shall hang compactly at the right side of the blinds and shall reach within 1500 mm of the floor. The bead chain tilting control shall tilt all vanes simultaneously to any desired angle and hold them at that angle. The louvers shall traverse one way to the right. The traversing control cord shall be minimum 1.78 mm in diameter with a minimum breaking strength of 556 N. The cord shall be anchored to a lead carrier which shall be linked to all adjacent carriers. The louvers shall be traversed along the headrail by pulling one side of the looped cord. A weighted pulley shall be provided at the bottom of the cord.

2.1.2.6 Connectors and Spacers

The connector shall be flexible, smooth and flat to slide unhindered when carriers move independently of each other, and to nest compactly when carriers are stacking. The length of the links shall relate to the louver width in order to equally space the traversing louvers, to maintain uniform and adequate overlap of louvers, and to fully cover the width of the opening.

2.1.2.7 Intermediate Brackets

Intermediate installation brackets shall be furnished for blinds over 1575 mm wide.

2.2 NOT USED

2.3 COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 WINDOW TREATMENT PLACEMENT SCHEDULE

Window covering shall be provided as follows:

Place vertical blinds at window types ("A", "D", "F" in the Training Building and Types "A" and "B" in the OMS.)

Place horizontal blinds at sidelights windows in Rooms 105, 106, 107, 108, 109.

3.2 INSTALLATION

Installation shall be in accordance with the approved detail drawings and manufacturer's installation instructions. Units shall be level, plumb, secure, and at proper height and location relative to window units. The Contractor shall furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Installation

shall not be initiated until completion of room painting and finishing operations. Upon completion of the installation, window treatments shall be adjusted for form and appearance, shall be in proper operating condition, and shall be free from damage or blemishes. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

-- End of Section --

SECTION 13100A

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 780	(1997) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96	(1994; Rev thru Jan 2000) Lightning Protection Components
UL 96A	(1994; Rev thr Jul 1998) Installation Requirements for Lightning Protection Systems
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL Elec Const Dir	(1999) Electrical Construction EquipmentDirectory

1.2 GENERAL REQUIREMENTS

1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

1.2.2 System Requirements

The system furnished under this specification shall consist of the standard

products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G, RE

Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

SD-07 Certificates

Materials; G, RE

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label of or listing in UL Elec Const Dir will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted. A letter of findings shall be submitted certifying UL inspection of lightning protection systems.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be

electrically connected at the upper and lower ends.

2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

2.1.2.1 Copper

Copper conductors used on nonmetallic stacks shall weigh not less than 170 kg per 300 m (375 pounds per thousand feet), and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 1/0 AWG.

2.1.2.2 Aluminum

Aluminum shall not contact the earth nor shall it be used in any other manner that will contribute to rapid deterioration of the metal. Appropriate precautions shall be observed at connections with dissimilar metals. Aluminum conductors for bonding and interconnecting metallic bodies to the main cable shall be at least equivalent to strength and cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, strips that are much wider than solid strips shall be. A strip width that is at least twice that of the diameter of the perforations shall be used. Aluminum strip for connecting exposed water pipes shall be not less than No. 12 AWG in thickness and at least 38.1 mm wide.

2.1.3 Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780. Air terminals more than 600 mm in length shall be supported by a suitable brace, with guides not less than one-half the height of the terminal.

2.1.4 Ground Rods

Rods made of copper-clad steel shall conform to UL 467 and galvanized ferrous rods shall conform to ANSI C135.30. Ground rods shall be not less than 19.1 mm (3/4 inch) in diameter and 3.048 m (10 feet) in length. Ground rods of copper-clad steel, stainless steel, galvanized ferrous, and solid copper shall not be mixed on the job.

2.1.5 Connectors

Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation.

2.1.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

3.1.1 General Requirements

The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

3.1.1.1 Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 600 mm (2 feet) from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 600 mm (2 feet) in height on ridges, parapets shall not exceed 7.5 meters. In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 50 mm for each 300 mm of increase over 7.5 meters. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings, and other metal objects that do not contain hazardous materials and that may be struck but not appreciably damaged by lightning, need not be provided with air terminals. However, these metal objects shall be bonded to the lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed, air terminals shall be mounted thereon, where practicable. Any air terminal erected by necessity adjacent to a metal ventilator shall be bonded to the ventilator near the top and bottom. Where metal ventilators are installed with air terminals mounted thereon, the air terminal shall not be more than 610 mm away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement. Where metal ventilators are installed with air terminals mounted adjacent, the air terminal shall not be more than 610 mm away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement.

3.1.1.2 Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 200 mm. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 900 mm

along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Roof conductors surrounding tank tops, and decks shall be connected to form a closed loop.

3.1.1.3 Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. On rectangular structures having gable, hip, or gambrel roofs more than 35 m long, there shall be at least one additional down conductor for each additional 15 m of length or fraction thereof. On rectangular structures having French, flat, or sawtooth roofs exceeding 75 m in perimeter, there shall be at least one additional down conductor for each 30 m of perimeter or fraction thereof. On an L- or T-shaped structure, there shall be at least one additional down conductor; on an H-shaped structure, at least two additional down conductors; and on a wing-built structure, at least one additional down conductor for each wing. On irregularly shaped structures, the total number of down conductors shall be sufficient to make the average distance between them along the perimeter not greater than 30 meters. On structures exceeding 15 m in height, there shall be at least one additional down conductor for each additional 18 m of height or fraction thereof, except that this application shall not cause down conductors to be placed about the perimeter of the structure at intervals of less than 15 meters. Additional down conductors shall be installed when necessary to avoid "dead ends" or branch conductors ending at air terminals, except where the air terminal is on a roof below the main protected level and the "dead end" or branch conductor is less than 5 m in length and maintains a horizontal or downward coursing. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure. Down conductors shall be protected by placing in pvc conduit for a minimum distance of 1800 mm above finished grade level.

3.1.1.4 Interconnection of Metallic Parts

Gutters shall be connected directly to the grounds or down conductors using not smaller than No. 6 copper conductor, or equivalent. Conductors placed where there is probability of unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected.

3.1.1.5 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a

ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall extend into the earth for a distance of not less than 3.0 meters. Ground rods shall be set not less than 900 mm, nor more than 2.5 m, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 25 ohms if a counterpoise is not used. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 48 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 25 ohms, the Contracting Officer shall be notified immediately. A counterpoise, where required, shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 600 mm deep at a distance not less than 900 mm nor more than 2.5 m from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors are then buried in the trenches.

3.1.2 Metal Roofs

Wall-Bearing Masonry with Metallic Roof and Nonmetallic Exterior Walls, or Reinforced Concrete Building with Metallic Roof: Metal roofs which are in the form of sections insulated from each other shall be made electrically continuous by bonding. Air terminals shall be connected to, and made electrically continuous with, the metal roof as well as the roof conductors and down conductors. Ridge cables and roof conductors shall be bonded to the roof at the upper and lower edges of the roof and at intervals not to exceed 30 meters. The down conductors shall be bonded to roof conductors and to the lower edge of the metal roof. Where the metal of the roof is in small sections, the air terminals and down conductors shall have connections made to at least four of the sections. All connections shall have electrical continuity and have a surface contact of at least 1935 square millimeters (3 square inches).

3.1.3 NOT USED

3.1.4 Steel Frame Building

The steel framework shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding steel frame, unless a specific method is noted on the drawings. The air terminals shall

be connected to the structural steel framework at the ridge. Where a grounded metal pipe water system enters the building, the structural steel framework and the water system shall be connected at the point of entrance by a ground connector. Connections to pipes shall be by means of ground clamps with lugs. Connections to structural framework shall be by means of nut and bolt or welding. All connections between columns and ground connections shall be made at the bottom of the steel columns. Ground connections to grounding electrodes or counterpoise shall be run from not less than one-half of all the columns distributed equally around the perimeter of the structure at intervals averaging not more than 18 meters.

3.2 NOT USED

3.3 NOT USED

3.4 INTERCONNECTION OF METAL BODIES

Metal bodies of conductance shall be protected if not within the zone of protection of an air terminal. Metal bodies of conductance having an area of 0.258 square meters (400 square inches) or greater or a volume of 0.0164 cubic meters (1000 cubic inches) or greater shall be bonded to the lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 1935.5 square millimeters (3 square inches).Provisions shall be made to guard against the corrosive effect of bonding dissimilar metals. Metal bodies of inductance shall be bonded at their closest point to the lightning protection system using secondary bonding conductors and fittings. A metal body that exceeds 1.5 m in any dimension, that is situated wholly within a building, and that does not at any point come within 1.8 m of a lightning conductor or metal connected thereto shall be independently grounded.

3.5 FENCES

Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 600 mm into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 300 to 450 m of length when fences are located in isolated places, and every 150 to 225 m when in proximity (30 m or less) to public roads, highways, and buildings. Where the fence consists of wooden posts and horizontal metal strands only, down conductors consisting of No. 8 copper wire or equivalent shall be run from the ground rod the full height of the fence and fastened to each wire, so as to be electrically continuous. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing. All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 45 m on each side of line crossings.

3.6 NOT USED

3.7 NOT USED

3.8 FIELD QUALITY CONTROL

3.8.1 Periodic Inspections

Engage an LPI Inspector to perform periodic inspections during construction and its completion, according to LPI-77.

3.8.2 UL Inspector

Apply for inspection by UL as required to obtain a UL Master Label for system.

3.9 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

SECTION 13110

CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 418	(1995a) Cast and Wrought Galvanic Zinc Anodes
ASTM B 843	(1993; R 1998) Magnesium Alloy Anodes for Cathodic Protection
ASTM D 1248	(1998) Polyethylene Plastics Molding and Extrusion Materials

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192	Transportation of Natural and other Gas by Pipeline: Minimum Federal Safety Standards

NACE INTERNATIONAL (NACE)

NACE RP0169	(1996) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0177	(1995) Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
NACE RP0188	(1999) Discontinuity (Holiday) Testing of Protective Coatings
NACE RP0190	(1995) External Protective Coatings for Joints, Fittings, and Valves on Metallic Underground or Submerged Pipelines and Piping Systems
NACE RP0193	(1993) External Cathodic Protection of

	On-Grade Metallic Storage Tank Bottoms
NACE RP0285	(1995) Corrosion Control of Underground Storage Tank Systems by Cathodic Protection

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA WC 5	(1992; Rev 2, 1996) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G, RE

Six copies of detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, results of system design calculations including soil-resistivity, installation instructions and certified test data stating the maximum recommended anode current output density and the rate of gaseous production if any at that current density. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function properly as a unit.

SD-03 Product Data

Equipment; G, RE

Within 30 days after receipt of notice to proceed, an itemized list of equipment and materials including item number, quantity, and manufacturer of each item. The list shall be accompanied by a description of procedures for each type of testing and adjustments, including testing of coating for thickness and holidays. Installation of materials and equipment shall not commence until this submittal is approved.

Spare Parts; G, RE

Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than six (6) months prior to the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. One (1) spare anode of each type shall be furnished.

SD-06 Test Reports

Tests and Measurements; G, RE

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including close interval potential survey, casing and interference tests, final system test verifying protection, insulated joint and bond tests, and holiday coating test. A certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection, wherein the anode is subjected to maximum recommended current output while immersed in a three percent sodium chloride solution.

The report shall also include pipe-to-soil measurements throughout the affected area, indicating that the modifications improved the overall conditions, and current measurements for anodes. The following special materials and information are required: taping materials and conductors; zinc grounding cell, installation and testing procedures, and equipment; coating material; system design calculations for anode number, life, and parameters to achieve protective potential; backfill shield material and installation details showing waterproofing; bonding and waterproofing details; insulated resistance wire; exothermic weld equipment and material.

SD-07 Certificates

Cathodic Protection System; G, RE

Proof that the materials and equipment furnished under this section conform to the specified requirements contained in the referenced standards or publications. The label or listing by the

specified agency will be acceptable evidence of such compliance.

Services of "Corrosion Expert"; G, RE

Evidence of qualifications of the "corrosion expert."

a. The "corrosion expert's" name and qualifications shall be certified in writing to the Contracting Officer prior to the start of construction.

b. Certification shall be submitted giving the name of the firm, the number of years of experience, and a list of not less than five (5) of the firm's installations three (3) or more years old that have been tested and found satisfactory.

SD-10 Operation and Maintenance Data

Cathodic Protection System; G, RE

Before final acceptance of the cathodic protection system, six copies of operating manuals outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance manual, listing routine maintenance procedures, recommendation for maintenance testing, possible breakdowns and repairs, and troubleshooting guides. The manuals shall include single-line diagrams for the system as installed; instructions in making pipe-to-reference cell and tank-to-reference cell potential measurements and frequency of monitoring; instructions for dielectric connections, interference and sacrificial anode bonds; instructions shall include precautions to ensure safe conditions during repair of pipe or other metallic systems. The instructions shall be neatly bound between permanent covers and titled "Operating and Maintenance Instructions." These instructions shall be submitted for the Contracting Officer's approval. The instructions shall include the following:

a. As-built drawings, to scale of the entire system, showing the locations of the piping, location of all anodes and test stations, locations of all insulating joints, and structure-to-reference cell potentials as measured during the tests required by Paragraph: TESTS AND MEASUREMENTS, of this section.

b. Recommendations for maintenance testing, including instructions in making pipe-to-reference cell potential measurements and frequency of testing.

c. All maintenance and operating instructions and nameplate data shall be in English.

d. Instructions shall include precautions to insure safe conditions during repair of pipe system.

Training Course; G, RE

The proposed Training Course Curriculum (including topics and dates of discussion) indicating that all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions, are to be covered.

1.3 GENERAL REQUIREMENTS

The Contractor shall design, furnish and install a complete, operating, sacrificial anode cathodic protection system in complete compliance with NFPA 70, with all applicable Federal, State, and local regulations and with minimum requirements of this contract. In addition to the minimum requirements of these specifications, construction of gas pipelines and associated cathodic protection systems shall be in compliance with 49 CFR 192. The services required include planning, designing, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the Water, Fire Protection, Force Main, and Gas lines, their connectors and lines under the slab or floor foundation. The cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified. Insulators are required whenever needed to insulate the pipes from any other structure. The cathodic protection shall be provided on Water, Fire Protection, Force Main, and Gas pipes.

1.3.1 Services of "Corrosion Expert"

The Contractor shall obtain the services of a "corrosion expert" to design, supervise, inspect, and test the installation and performance of the cathodic protection system. "Corrosion expert" refers to a person, who by thorough knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. Such a person must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection (CP) Specialist or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metallic piping and tank systems, if such certification or licensing includes 5 years experience in corrosion control on underground metallic surfaces of the type under this contract. The "corrosion expert" shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required, in addition to obtaining any other pertinent field information, begin design of the system. Once the submittals are approved and the materials delivered, the "corrosion expert" shall revisit the site

the ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The "corrosion expert" shall design and supervise the installation and testing of all cathodic protection. The anode system shall be designed for a life of twenty-five (25) years of continuous operation. The general requirements, components, etc., listed in this specification are general and not necessarily tailored to this specific project. The corrosion expert shall use the materials listed in this specification if applicable. The complete design shall be the responsibility of the corrosion expert. Components and system listed in this specification are for retrace.

1.3.2 NOT USED

1.3.3 Isolators

Isolators are required to insulate the indicated pipes from any other structure. Isolators shall be provided with lightning protection and a test station as shown.

1.3.4 Anode and Bond Wires

Magnesium anodes shall be provided uniform distances along the metallic pipe lines with quantity and weight as required. Test stations shall be used for these anodes. These anodes shall be in addition to anodes for the pipe under concrete slab and casing requirements. For each cathodic system, the metallic components and structures to be protected shall be made electrically continuous. This shall be accomplished by installing bond wires between the various structures. Bonding of existing buried structures may also be required to preclude detrimental stray current effects and safety hazards. Contractor shall coordinate with eixsting buried utilities, refer to civil plans for locations. Provisions shall be included to return stray current to its source without damaging structures intercepting the stray current. The electrical isolation of underground facilities in accordance with acceptable industry practice shall be included under this section. All tests shall be witnessed by the Contracting Officer.

1.3.5 Surge Protection

Approved zinc grounding cells or sealed weatherproof lightning arrestor devices shall be installed across insulated flanges or fittings installed in underground piping as indicated on the drawings. The arrestor shall be gapless, self-healing, solid state type. Zinc anode composition shall conform to ASTM B 418, Type II. Lead wires shall be number 6 AWG copper with high molecular weight polyethylene (HMWPE) insulation. The zinc grounding cells shall not be prepackaged in backfill but shall be installed as detailed on the drawings. Lightning arrestors or zinc grounding cells are not required for insulated flanges on metallic components used on nonmetallic piping systems.

1.3.6 Summary of Services Required

The scope of services shall include, but shall not be limited to, the following:

a. Close-interval potential surveys.

b. Cathodic Protection Systems.

c. System testing.

d. Casing corrosion control.

e. Interference testing.

f. Training.

g. Operating and maintenance manual.

h. Insulator testing and bonding testing.

i. Coating and holiday testing shall be submitted within 45 days of notice to proceed.

1.3.7 Nonmetallic Pipe System

In the event pipe other than metallic pipe is approved and used in lieu of metallic pipe, all metallic components of this pipe system shall be protected with cathodic protection. Detailed drawings of cathodic protection for each component shall be submitted to the Contracting Officer for approval within 45 days after date of receipt of notice to proceed, and before commencement of any work.

1.3.7.1 Coatings

Coatings for metallic components shall be as required for metallic fittings. Protective covering (coating and taping) shall be completed and tested on each metallic component (such as valves, hydrants and fillings). This covering shall be as required for underground metallic pipe. Each test shall be witnessed by the Contracting Officer. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications. The use of nonmetallic pipe does not change other requirements of the specifications. Any deviations due to the use of nonmetallic pipe shall be submitted for approval.

1.3.7.2 Tracer Wire

When a nonmetallic pipe line is used to extend or add to an existing metallic line, an insulated No. 8 AWG copper wire shall be thermit-welded to the existing metallic line and run the length of the new nonmetallic line. This wire shall be used as a locator tracer wire and to maintain continuity to any future extensions of the pipe line.

1.3.8 Tests of Components

A minimum of four (4) tests shall be made at each metallic component in the

piping system. Two (2) measurements shall be made directly over the anodes and the other two (2) tests shall be over the outer edge of the component, but at the farthest point from the anodes. Structure and pipes shall be shown with the cathodic protection equipment. All components of the cathodic protection system shall be shown on the shop drawings, showing their relationship to the protected structure or component. A narrative shall describe how the cathodic protection system will work and provide testing at each component. Components requiring cathodic protection shall include but not be limited to the following:

a. Pipes under the floor slab or foundations.

b. PIV.

c. Shutoff valves.

d. Metallic pipe extended from aboveground locations.

e. Each connector or change-of-direction device.

f. Any metallic pipe component or section.

g. Backflow preventor.

h. Culvert.

1.3.9 Drawings

Detailed drawings shall be provided showing location of anodes, insulated fittings, test stations, permanent reference cells, and bonding. Locations shall be referenced to two (2) permanent facilities or mark points.

1.3.10 Electrical Potential Measurements

All potential tests shall be made at a minimum of 3 meter intervals witnessed by the Contracting Officer. Submittals shall identify test locations on separate drawing, showing all metal to be protected and all cathodic protection equipment. Test points equipment and protected metal shall be easily distinguished and identified.

1.3.11 Achievement of Criteria for Protection

All conductors, shall be routed to or through the test stations. Each system provided shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolt potentials with reference to a saturated copper-copper-sulfate reference cell on all underground components of the piping. Based upon the measurements taken, the current and voltage of the anodes should be adjusted as required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference cell. This potential should be obtained over 95 percent of the metallic area. This must be achieved without the "instant off" potential exceeding 1150 millivolts. Testing will be witnessed by the Contracting Officer. Additional anodes shall be provided by the Contractor if required to achieve the minus 850 millivolts "instant off". Although

acceptance criteria of the cathodic protection systems are defined in NACE RP0169, for this project the "instant off" potential of minus 850 millivolts is the only acceptable criteria.

1.3.12 Metallic Components and Typicals

a. Metallic components: Each metallic component shall be protected with magnesium anodes with quantity and weight as required. This number of anodes is required to achieve minus 850 millivolts "instant off" potential on the metallic area and at the same time not provide overvoltage above 1150 millivolts "instant off." The magnesium anodes shall be located on each side of the metallic component and routed through a test station.

b. Fire Hydrants: Fire hydrant pipe components shall have anodes with quantity and weight as required.

c. Pipe Under Concrete Slab: Pipe under concrete slab shall have magnesium anodes with quantity and weight as required. Pipe under concrete slab shall have permanent reference electrodes located under the slab. One (1) permanent reference electrode shall be located where the pipe enters the concrete slab. All conductors shall be routed to a test station.

d. Valves: Each valve shall be protected with magnesium anodes with quantity and weight as required.

e. Metallic Pipe Component or Section: Each section of metallic pipe shall be protected with magnesium anodes with quantity and weight as required.

f. Connectors or Change-of-Direction Devices: Each change-of-direction device shall be protected with magnesium anodes with quantity and weight as required.

1.3.13 Metallic Component Coating

Coatings for metallic components shall be as required for metallic fittings as indicated. This will include fire hydrants, T's, elbows, valves, etc. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications.

PART 2 PRODUCTS

2.1 MAGNESIUM ANODES

Magnesium anodes shall be installed on the Pipe system with quantity and weight as required. See Paragraph METALLIC COMPONENTS AND TYPICALS for additional anodes under slab.

2.1.1 Anode Composition

Anodes shall be of high-potential magnesium alloy, made of primary magnesium obtained from sea water or brine, and not made from scrap metal. Magnesium anodes shall conform to ASTM B 843 and to the following analysis (in percents) otherwise indicated:

Aluminum, max.	0.010
Manganese, max.	0.50 to 1.30
Zinc	0.05
Silicon, max.	0.05
Copper, max.	0.02
Nickel, max.	0.001
Iron, Max.	0.03
Other impurities, max.	0.05 each or 0.3 max. total
Magnesium	Remainder

The Contractor shall furnish spectrographic analysis on samples from each heat or batch of anodes used on this project.

2.1.2 Dimensions and Weights

Dimensions and weights of anodes shall be approximately as follows:

TYPICAL MAGNESIUM ANODE SIZE

(Cross sections may be round, square, or D shaped)

NOMINAL WT. kg.	APPROX. SIZE (mm)	NOMINAL GROSS WT kg PACKAGED IN BACKFILL	NOMINAL PACKAGE DIMENSIONS (mm)
1.4	76 X 76 X 127	3.6	133 X 133 X 203
2.3	76 X 76 X 203	5.9	133 X 133 X 286
4.1	76 X 76 X 356	12.3	133 X 508
5.5	102 X 102 X 305	14.5	191 X 457
7.7	102 X 102 X 432	20.5	191 X 610
14.5	127 X 127 X 521	30.9	216 X 711
22.7	178 X 178 X 406	45.5	254 X 610

2.1.3 Packaged Anodes

Anodes shall be provided in packaged form with the anode surrounded by specially-prepared quick-wetting backfill and contained in a water permeable cloth or paper sack. Anodes shall be centered by means of spacers in the backfill material. The backfill material shall have the following composition, unless otherwise indicated:

Material	Approximate Percent by Weight
Gypsum	75
Bentonite	20
Sodium Sulphate	5
Total	100

2.1.4 Zinc Anodes

Zinc anodes shall conform to ASTM B 418, Type II.

2.1.5 Connecting Wire

2.1.5.1 Wire Requirements

Wire shall be solid copper wire, not less than 3 meters long, unspliced, complying with NFPA 70, Type RHH insulation.

2.1.5.2 Anode Header Cable

Cable for anode header and distribution shall be stranded copper wire with type CP high molecular weight polyethylene, 2.8 mm thick insulation, 600-volt rating, in accordance with NEMA WC 5.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Electrical Wire

Wire shall be stranded copper wire with NFPA 70, Type TW, RHW-USE, RHW-USE, or Polyethylene insulation. Polyethylene insulation shall comply with the requirements of ASTM D 1248 and shall be of the following types, classes, and grades:

High-molecular weight polyethylene shall be Type I, Class C, Grade E5.

High-density polyethylene shall be Type III, Class C, Grade E3.

2.2.1.1 Wire Splicing

Connecting wire splicing shall be made with copper compression connectors or exothermic welds, following instructions of the manufacturer. Single split-bolt connections shall not be used. Sheaths for encapsulating electrical wire splices to be buried underground shall fit the insulated wires entering the spliced joints and epoxy potting compound shall be as specified below.

2.2.1.2 Test Wires

Test wires shall be AWG No. 12 stranded copper wire with NFPA 70, Type TW or RHW or polyethylene insulation.

2.2.1.3 Resistance Wire

Resistance wire shall be AWG No. 16 or No. 22 nickel-chromium wire.

2.2.2 Conduit

Rigid galvanized steel conduit and accessories shall conform to UL 6. Non metallic conduit shall conform to NEMA TC 2.

2.2.3 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

2.2.4 Joint, Patch, Seal, and Repair Coating

Sealing and dielectric compound shall be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound shall be applied as recommended by the manufacturer, but not less than 13 mm thick. Coating compound shall be cold-applied coal-tar base mastic or hot-applied coal-tar enamel. Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.2.5 Backfill Shields

Shields shall consist of approved pipeline wrapping or fiberglass-reinforced, coal-tar impregnated tape, or plastic weld caps, specifically made for the purpose and installed in accordance with the manufacturer's recommendations. When joint bonds are required, due to the use of mechanical joints, the entire joint shall be protected by the use of a kraft paper joint cover. The joint cover shall be filled with poured-in, hot coat-tar enamel.

2.2.6 Epoxy Potting Compound

Compound for encapsulating electrical wire splices to be buried underground shall be a two package system made for the purpose.

2.2.7 Test Stations

Stations shall be of the flush-curb-box type and shall be the standard product of a recognized manufacturer. Test stations shall be complete with an insulated terminal block having the required number of terminals. The test station shall be provided with a lockable over and shall have an embossed legend, "C.P. Test." A minimum of one (1) test station shall be provided for each component of the pipe. A minimum of six (6) terminals shall be provided in each test station. A minimum of two (2) leads are required to the metallic pipe from each test station. Other conductors shall be provided for each anode, other foreign pipe, and reference cells as required. Test stations may be constructed of nonmetallic materials. However, if nonmetallic materials are utilized, as a minimum, the materials shall be resistant to damage from ultraviolet radiation, contain good color retention qualities, contain high strength qualities, and be resistant to accidental or vandalistic impacts that might be normally encountered in the environment for which they are to be installed. The test stations shall be listed for the particular application for which they are to be utilized.

2.2.8 Joint and Continuity Bonds

Bonds shall be provided across all joints in the metallic water and gas lines, across any electrically discontinuous connections and all other pipes and structures with other than welded or threaded joints that are included in this cathodic protection system. Unless otherwise specified in the specifications, bonds between structures and across joints in pipe with other than welded or threaded joints shall be No. 8 AWG stranded copper cable with polyethylene insulation. Bonds between structures shall contain sufficient slack for any anticipated movement between structures. Bonds across pipe joints shall contain a minimum of 102 mm of slack to allow for

pipe movement and soil stress. Bonds shall be attached by exothermic welding. Exothermic weld areas shall be insulated with coating compound and approved, and witnessed by the Contracting Officer. Continuity bonds shall be installed as necessary to reduce stray current interference. Additional joint bondings shall be accomplished by the Contractor where the necessity is discovered during construction or testing or where the Contracting Officer's representative directs that such bonding be done. Joint bonding shall include all associated excavation and backfilling. There shall be a minimum of two (2) continuity bonds between each structure and other than welded or threaded joints. The Contractor shall test for electrical continuity across all joints with other than welded or threaded joints and across all metallic portions or components. The Contractor shall provide bonding as required and as specified above until electrical continuity is achieved. Bonding test data shall be submitted for approval.

2.2.9 Resistance Bonds

Resistance bonds should be adjusted as outlined in this specification. Alternate methods may be used if they are approved by the Contracting Officer.

2.2.10 Stray Current Measurements

Stray current measurements should be performed at each test station. Stray currents resulting from lightning or overhead alternating current (AC) power transmission systems shall be mitigated in accordance with NACE RP0177.

2.2.11 Electrical Isolation of Structures

As a minimum, isolating flanges or unions shall be provided at the following locations:

a. Connection of new metallic piping or components to existing piping.

b. Pressure piping under floor slab to a building.

Isolation shall be provided at metallic connection of all lines to existing system and where connecting to a building. Additionally, isolation shall be provided between water and/or gas forced main line; and foreign pipes that cross the new lines within 3.05 m. Isolation fittings, including isolating flanges and couplings, shall be installed aboveground or in a concrete pit.

2.2.11.1 Electrically Isolating Pipe Joints

Electrically isolating pipe joints shall be of a type that is in regular factory production.

2.2.11.2 Electrically Conductive Couplings

Electrically conductive couplings shall be of a type that has a published maximum electrical resistance rating given in the manufacturer's literature. Cradles and seals shall be of a type that is in regular

factory production made for the purpose of electrically insulating the carrier pipe from the casing and preventing the incursion of water into the annular space.

2.2.11.3 Insulating Joint Testing

A Model 601 Insulation Checker, as manufactured by "Gas Electronics", or equal, shall be used for insulating joint (flange) electrical testing.

2.2.12 Underground Structure Coating

All underground metallic pipelines and tanks to be cathodically protected shall be afforded a good quality factory-applied coating. This includes all carbon steel, cast-iron and ductile-iron pipelines or vessels. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified. If non-metallic pipelines are installed, all metallic fittings on pipe sections shall be coated in accordance with this specification section.

a. Pipe and joint coating for factory applied or field repair material shall be applied as recommended by the manufacturer and shall be one of the following:

(1) Continuously extruded polyethylene and adhesive coating system.
(2) Polyvinyl chloride pressure-sensitive adhesive tape.
(3) High density polyethylene/bituminous rubber compound tape.
(4) Butyl rubber tape.
(5) Coal tar epoxy.

2.2.12.1 Field Joints

All field joints shall be coated with materials compatible with the pipeline coating compound. The joint coating material shall be applied to an equal thickness as the pipeline coating. Unbonded coatings shall not be used on these buried metallic components. This includes the elimination of all unbonded polymer wraps or tubes. Once the pipeline or vessel is set in the trench, an inspection of the coating shall be conducted. This inspection shall include electrical holiday detection. Any damaged areas of the coating shall be properly repaired. The Contracting Officer shall be asked to witness inspection of the coating and testing using a holiday detector.

2.2.12.2 Inspection of Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation. After field coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE RP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. All holidays in the protective covering shall be repaired immediately upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer's representative to

determine suitability of the detector. All labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor.

a. Protective covering for aboveground piping system: Finish painting shall conform to the applicable paragraph of SECTION: 09900, PAINTING, GENERAL, and as follows:

b. Ferrous surfaces: Shop-primed surfaces shall be touched-up with ferrous metal primer. Surfaces that have not been shop-primed shall be solvent-cleaned. Surfaces that contain loose rust, loose mil scale, and other foreign substances shall be mechanically-cleaned by power wire-brushing and primed with ferrous metal primer. Primed surface shall be finished with two (2) coats of exterior oil paint and vinyl paint. Coating for each entire piping service shall be an approved pipe line wrapping having a minimum coating resistance of 50,000 Ohms per 0.0929 square meters.

2.2.13 Resistance Wire

Wire shall be No. 16 or No. 22 nickel-chromium wire with TW insulation.

2.2.14 Electrical Connections

Electrical connections shall be done as follows:

a. Exothermic welds shall be "Cadweld", " Bundy", "Thermoweld", or equal. Use of this material shall be in strict accordance with the manufacturer's recommendations.

b. Electrical-shielded arc welds shall be approved for use on steel pipe by shop drawing submittal action.

c. Brazing shall be as specified in Paragraph: Lead Wire Connections.

2.2.15 Electrical Tape

Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.2.16 Permanent Reference Electrodes

Permanent reference electrodes shall be Cu-CuS04 electrodes suitable for direct burial. Electrodes shall be guaranteed by the supplier for 15 years' service in the environment in which they shall be placed. Electrodes shall be installed directly beneath pipe, or metallic component.

2.2.17 Casing

Where a pipeline is installed in a casing under a roadway or railway, the pipeline shall be electrically insulated from the casing, and the annular space sealed and filled with an approved corrosion inhibiting product against incursion of water.

PART 3 EXECUTION

3.1 CRITERIA OF PROTECTION

Acceptance criteria for determining the adequacy of protection on a buried underground pipe or metallic component shall be in accordance with NACE RP0169, NACE RP0193, NACE RP0285, and as specified below.

3.1.1 Iron and Steel

The following method (a) shall be used for testing cathodic protection voltages. If more than one method is required, method (b) shall be used.

a. A negative voltage of at least minus 850 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode connecting the earth (electrolyte) directly over the underground component. Determination of this voltage shall be made with the cathodic protection system in operation. Voltage drops shall be considered for valid interpretation of this voltage measurement. A minimum of minus 850 millivolts "instant off" potential between the underground component being tested and the reference cell shall be achieved over 95 percent of the area of the structure. Adequate number of measurements shall be obtained over the entire structure, pipe, tank, or other metallic component to verify and record achievement of minus 850 millivolts "instant off." This potential shall be obtained over 95 percent of the total metallic area without the "instant off" potential exceeding 1200 millivolts.

b. A minimum polarization voltage shift of 100 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode contacting the earth directly over the underground component. This polarization voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. When the protective current is interrupted, an immediate voltage shift will occur. The voltage reading, after the immediate shift, shall be used as the base reading from which to measure polarization decay. Measurements achieving 100 millivolts decay shall be made over 95 percent of the metallic surface being protected.

c. For any metallic component, a minimum of four (4) measurements shall be made using subparagraph (a), above, and achieving the "instant off" potential of minus 850 millivolts. Two (2) measurements shall be made over the anodes and two (2) measurements shall be made at different locations near the component and farthest away from the anode.

3.1.2 Aluminum

Aluminum underground component shall not be protected to a potential more negative than minus 1200 millivolts, measured between the underground component and a saturated copper-copper sulphate reference electrode contacting the earth, directly over the metallic component. Resistance, if required, shall be inserted in the anode circuit within the test station to reduce the potential of the aluminum to a value which will not exceed a potential more negative than minus 1200 millivolts. Voltage shift criterion shall be a minimum negative polarization shift of 100 millivolts

measured between the metallic component and a saturated copper-copper sulphate reference electrode contacting the earth, directly over the metallic component. The polarization voltage shift shall be determined as outlined for iron and steel.

3.1.3 Copper Piping

For copper piping, the following criteria shall apply: A minimum of 100 millivolts of cathodic polarization between the structure surface and a stable reference electrode contacting the electrolyte. The polarization voltage shift shall be determined as outlined for iron and steel.

3.2 ANODE STORAGE AND INSTALLATION

3.2.1 Anode Storage

Storage area for magnesium anodes will be designated by the Contracting Officer. If anodes are not stored in a building, tarps or similar protection should be used to protect anodes from inclement weather. Packaged anodes, damaged as a result of improper handling or being exposed to rain, shall be resacked by the Contractor and the required backfill added.

3.2.2 Anode Installation

Unless otherwise authorized, installation shall not proceed without the presence of the Contracting Officer. Anodes of the size specified shall be installed to the depth indicated and at the locations shown. Locations may be changed to clear obstructions with the approval of the Contracting Officer. Anodes shall be installed in sufficient number and of the required type, size, and spacing to obtain a uniform current distribution over the surface of the structure. The anode system shall e designed for a life of 25 years of continuous operation. Anodes shall be installed as indicated in a dry condition after any plastic or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire shall not be used for lowering the anode into the hole. The annular space around the anode shall be backfilled with fine earth in 150 mm layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 20liters of water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 150 mm above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

3.2.2.1 Single Anodes

Single anodes shall be connected through a test station to the pipeline, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.

3.2.2.2 Groups of Anodes

Groups of anodes shall be connected to an anode header cable. The anode header cable shall make contact with the structure to be protected only through a test station. Anode lead connection to the anode header cable shall be made by an approved crimp connector or exothermic weld and splice mold kit with appropriate potting compound.

3.2.2.3 Welding Methods

Connections to ferrous pipe shall be made by exothermic weld methods manufactured for the type of pipe supplied. Electric arc welded connections and other types of welded connections to ferrous pipe and structures shall be approved before use.

3.2.3 Anode Placement - General

Packaged anodes shall be installed completely dry, and shall be lowered into holes by rope sling or by grasping the cloth gather. The anode lead wire shall not be used in lowering the anodes. The hole shall be backfilled with fine soil in 150 mm layers and each layer shall be hand-tamped around the anode. Care must be exercised not to strike the anode or lead wire with the tamper. If immediate testing is to be performed, water shall be added only after backfilling and tamping has been completed to a point 150 mm above the anode. Approximately 8 liters of water may be poured into the hole. After the water has been absorbed by the soil, backfilling and tamping may be completed to the top of the hole. Anodes shall be installed as specified or shown. In the event a rock strata is encountered prior to achieving specified augered-hole depth, anodes may be installed horizontally to a depth at least as deep as the bottom of the pipe, with the approval of the Contracting Officer.

3.2.4 Underground Pipeline

Anodes shall be installed at a minimum of 2.5 meters and a maximum of3 meters from the line to be protected.

3.2.5 NOT USED

3.2.6 Lead Wire Connections

3.2.6.1 Underground Pipeline (Metallic)

To facilitate periodic electrical measurements during the life of the sacrificial anode system and to reduce the output current of the anodes, if required, all anode lead wires shall be connected to a test station and buried a minimum of 610 mm in depth. The cable shall be No. 10 AWG, stranded copper, polyethylene or RHW-USE insulated cable. The cable shall make contact with the structure only through a test station. Resistance wire shall be installed between the cable and the pipe cable, in the test station, to reduce the current output, if required. Anode connections, except in the test station, shall be made with exothermic welding process, and shall be insulated by means of at least three (3) layers of electrical tape; and all lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin. Lead wire-to-structure

connections shall be accomplished by an exothermic welding process. All welds shall be in accordance with the manufacturer's recommendations. A backfill shield filled with a pipeline mastic sealant or material compatible with the coating shall be placed over the weld connection and shall be of such diameter as to cover the exposed metal adequately.

3.2.6.2 Resistance Wire Splices

Resistance wire connections shall be accomplished with silver solder and the solder joints wrapped with a minimum of three (3) layers of pressure-sensitive tape. Lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin.

3.2.7 Location of Test Stations

Test stations shall be of the type and location shown and shall be curb box mounted. Buried insulating joints shall be provided with test wire connections brought to a test station. Unless otherwise shown, other test stations shall be located as follows:

a. At 300 m intervals or less.

b. Where the pipe or conduit crosses any other metal pipe.

c. At both ends of casings under roadways and railways.

d. Where both sides of an insulating joint are not accessible above ground for testing purposes.

3.2.8 Underground Pipe Joint Bonds

Underground pipe having other than welded or threaded coupling joints shall be made electrically continuous by means of a bonding connection installed across the joint.

3.3 ELECTRICAL ISOLATION OF STRUCTURES

3.3.1 Isolation Joints and Fittings

Isolating fittings, including main line isolating flanges and couplings, shall be installed aboveground, or within manholes, wherever possible. Where isolating joints must be covered with soil, they shall be fitted with a paper joint cover specifically manufactured for covering the particular joint, and the space within the cover filled with hot coal-tar enamel. Isolating fittings in lines entering buildings shall be located at least 305 mm above grade of floor level, when possible. Isolating joints shall be provided with grounding cells to protect against over-voltage surges or approved surge protection devices. The cells shall provide a low resistance across isolating joint without excessive loss of cathodic current.

3.3.2 Gas Distribution Piping

Electrical isolation shall be provided at each building riser pipe to the

pressure regulator, at all points where a short to another structure or to a foreign structure may occur, and at other locations as indicated on the drawings.

3.4 TRENCHING AND BACKFILLING

Trenching and backfilling shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS.

3.5 TESTS AND MEASUREMENTS

3.5.1 Baseline Potentials

Each test and measurement will be witnessed by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of five (5) working days prior to each test. After backfill of the pipe, the static potential-to-soil of the pipe shall be measured. The initial measurements shall be recorded.

3.5.2 Isolation Testing

Before the anode system is connected to the pipe, an isolation test shall be made at each isolating joint or fitting. This test shall demonstrate that no metallic contact, or short circuit exists between the two isolated sections of the pipe. Any isolating fittings installed and found to be defective shall be reported to the Contracting Officer.

3.5.2.1 Insulation Checker

A Model 601 insulation checker, as manufactured by "Gas Electronics", or equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. Testing shall conform to the manufacturer's operating instructions. Test shall be witnessed by the Contracting Officer. An isolating joint that is good will read full scale on the meter. If an isolating joint is shorted, the meter pointer will be deflected or near zero on the meter scale. Location of the fault shall be determined from the instructions, and the joint shall be repaired. If an isolating joint is located inside a vault, the pipe shall be sleeved with insulator when entering and leaving the vault.

3.5.2.2 Cathodic Protection Meter

A Model B3A2 cathodic protection meter, as manufactured by "M.C. Miller", or equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. This test shall be performed in addition to the Model 601 insulation checker. Continuity is checked across the isolation joint after the test lead wire is shorted together and the meter adjusted to scale. A full-scale deflection indicates the system is shorted at some location. The Model 601 verifies that the particular insulation under test is good and the Model B3A2 verifies that the system is isolated. If the system is shorted, further testing shall be performed to isolate the location of the short.

3.5.3 Anode Output

As the anodes or groups of anodes are connected to the pipe, current output shall be measured with an approved clamp-on milliammeter, calibrated shunt with a suitable millivoltmeter or multimeter, or a low resistance ammeter. (Of the three methods, the low-resistance ammeter is the least desirable and most inaccurate. The clamp-on milliammeter is the most accurate.) The valves obtained and the date, time, and location shall be recorded.

3.5.4 Reference Electrode Potential Measurements

Upon completion of the installation and with the entire cathodic protection system in operation, electrode potential measurements shall be made using a copper-copper sulphate reference electrode and a potentiometer-voltmeter, or a direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. The locations of these measurements shall be identical to the locations used for baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded. No less than eight (8) measurements shall be made over any length of line or component. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line.

3.5.5 Location of Measurements

3.5.5.1 Piping or Conduit

For coated piping or conduit, measurements shall be taken from the reference electrode located in contact with the earth, directly over the pipe. Connection to the pipe shall be made at service risers, valves, test leads, or by other means suitable for test purposes. Pipe-to-soil potential measurements shall be made at intervals not exceeding 1.5 meters. The Contractor may use a continuous pipe-to-soil potential profile in lieu of 1.5 meter interval pipe-to-soil potential measurements. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line adjacent to the riser. Potentials shall be plotted versus distance to an approved scale. Locations where potentials do not meet or exceed the criteria shall be identified and reported to the Contracting Officer's representative.

3.5.5.2 NOT USED

3.5.5.3 Casing Tests

Before final acceptance of the installation, the electrical separation of carrier pipe from casings shall be tested and any short circuits corrected.

3.5.5.4 Interference Testing

Before final acceptance of the installation, interference tests shall be made with respect to any foreign pipes in cooperation with the owner of the foreign pipes. A full report of the tests giving all details shall be made. Stray current measurements shall be performed at all isolating locations and at locations where the new pipeline crosses foreign metallic pipes. The method of measurements and locations of measurements shall be

submitted for approval. As a minimum, stray current measurements shall be performed at the following locations:

a. Connection point of new pipeline to existing pipeline.

b. Crossing points of new pipeline with existing lines.

Results of stray current measurements shall also be submitted for approval.

3.5.5.5 Holiday Test

Any damage to the protective covering during transit and handling shall be repaired before installation. After field-coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE RP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Holidays in the protective covering shall be repaired upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer to determine suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor. The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

3.5.5.6 Recording Measurements

All pipe-to-soil potential measurements, including initial potentials where required, shall be recorded. The Contractor shall locate, correct and report to the Contracting Officer any short circuits to foreign pipes encountered during checkout of the installed cathodic protection system. Pipe-to-soil potential measurements shall be taken on as many pipes as necessary to determine the extent of protection or to locate short-circuits.

3.6 TRAINING COURSE

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions. At least 14 days prior to date of proposed conduction of the training course, the training course curriculum shall be submitted for approval, along with the proposed training date. Training shall consist of demonstration of test equipment, providing forms for test data and the tolerances which indicate that the system works.

3.7 CLEANUP

The Contractor shall be responsible for cleanup of the construction site. All paper bags, wire clippings, etc., shall be disposed of as directed. Paper bags, wire clippings and other waste shall not be put in bell holes or anodes excavation.

3.8 MISCELLANEOUS INSTALLATION AND TESTING

3.8.1 Coatings

All aboveground pipeline shall be coated as indicated or as approved. The coating shall have a minimum thickness of 0.18 mm . The pipeline coating shall be in accordance with all applicable Federal, State, and local regulations.

3.8.2 Excavation

In the event rock is encountered in providing the required depth for anodes, the Contractor shall determine an alternate approved location and, if the depth is still not provided, an alternate plan shall be submitted to the Contracting Officer. Alternate techniques and depths must be approved prior to implementation.

3.9 SPARE PARTS

After approval of shop drawings, and not later than three (3) months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. In addition, the Contractor shall supply information for material and equipment replacement for all other components of the complete system, including anodes, cables, splice kits and connectors, corrosion test stations, and any other components not listed above. The Contractor shall furnish a reference cell on a reel with 120 m of conductor, along with other accessories, and a digital voltmeter that can be used in the maintenance of this cathodic protection system. Use of this equipment shall be demonstrated in actual tests during the training course, which shall include a description of the the equipment and measurement of the pipe-to-soil potential, rainfall, and gas company voltages.

3.10 SEEDING

Seeding shall be done by the Contractor, as directed, in all unsurfaced locations disturbed by this construction. In areas where grass cover exists, it is possible that sod can be carefully removed, watered, and stored during construction operations, and replaced after the operations are completed since it is estimated that no section of pipeline should remain uncovered for more than two (2) days. The use of sod in lieu of seeding shall require approval by the Contracting Officer.

3.11 SYSTEM TESTING

The Contractor shall submit a report including potential measurements taken at adequately-close intervals to establish that minus 850 millivolts potential, "instant-off" potential, is provided, and that the cathodic protection is not providing interference to other foreign pipes causing damage to paint or pipes. The report shall provide a narrative describing how the criteria of protection is achieved without damaging other pipe or

structures in the area.

3.12 CLEARING OF TREES AND UNDERBRUSH

In the areas of the anode beds, all trees and underbrush shall be cleared and grubbed to the limits shown or indicated.

-- End of Section --

SECTION 13121A

METAL BUILDING SYSTEMS (MINOR REQUIREMENTS)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA Design Manual	(2000) Aluminum Design Manual: Specification & Guidelines for Aluminum Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
AISC S342L	(1993) Load and Resistance Factor Design Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 252	(1998) Welded and Seamless Steel Pipe Piles
ASTM A 36/A 36M	(2000a) Carbon Structural Steel
ASTM A 463/A 463M	(2000) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 529/A 529M	(2000) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

ASTM A 572/A 572M	(2000a) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2000a) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1998) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607	(1998) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 618	(1999) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1999) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 209M	(2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221M	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 241/B 241M	(2000) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 308/B 308M	(2000) Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B 429	(2000) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 553	(1999) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color

	Coordinates
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000) Water Vapor Transmission of Materials

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1998) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA Low Rise Manual	(1996) Low Rise Building Systems Manual

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings
TI 809-07	(1998) Design of Cold-Formed Load Bearing Steel Systems and Masonry Veneer/Steel Stud Walls

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G, RE

Detail drawings consisting of catalog cuts, design and erection drawings.

SD-03 Product Data

Manufacturer's Instructions; G, RE

Manufacturer's literature for individual building component systems.

Qualifications; G, RE

Qualifications of the manufacturer, and qualifications and experience of the building erector. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall also include information regarding date of completion, name and address of owner, and how the structure is used.

SD-07 Certificates

Metal Building Systems; G, RE

a. A Certificate from the metal building manufacturer stating that the metal building was designed in accordance with MBMA Low Rise Manual.

b. Mill certification for structural bolts, framing steel, roofing and siding, and steel wall liner panels.

c. Warranty certificate. At the completion of the project the Contractor shall furnish signed copies of the 5 year Warranty for Metal Building Roof System, a sample copy of which is attached to this section, the 20-year Manufacturer's Material Warranties, and the Manufacturer's 20-year System Weathertightness Warranty where one is required.

Insulation; G, RE

Certificate attesting that the polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 GENERAL REQUIREMENTS

The metal building system covered under this specification shall be provided by a single manufacturer and shall include all components and assemblies that form a building. Structural Standing Seam Metal Roofing System, when specified, shall be furnished as part of a single manufacturer's system.

1.3.1 Building Configurations

Roof slope shall be as shown on the drawings. Buildings shall be single-span structures with one of the following framing systems: self-framing or rigid frame. Exterior doors and overhead doors shall be included in the metal building system. Building shall be a manufacturer's advertised product, except that dimensions shall be not less than those indicated. The minimum inside clear dimensions shall be as shown on the drawings.

1.3.2 Qualifications

1.3.2.1 Manufacturer

Metal building shall be the product of a recognized steel building systems manufacturer who has been in the practice of manufacturing steel buildings for a period of not less than 5 years. The manufacturer shall be chiefly engaged in the practice of designing and fabricating metal building systems.

1.3.2.2 Installer

Erector shall have specialized experience in the erection of steel building systems for a period of at least 3 years. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads acting on the exposed framing, such as wind loads and seismic forces, as well as loads due to erection equipment and erection operation. Structural members shall not be field cut or altered. Welds, abrasions, and surfaces not shop primed or galvanized shall be primed after erection.

1.4 DESIGN REQUIREMENTS

Criteria and definitions shall be in accordance with MBMA Low Rise Manual, except criteria for seismic loads shall be in accordance with TI 809-04 and other loads and load combinations in accordance with ASCE 7.

1.4.1 NOT USED

1.4.2 Structural Members and Connections

Structural steel members and their connections shall be designed in accordance with AISC ASD Manual or AISC S342L. Structural cold-formed steel framing members and their connections shall be designed in accordance with TI 809-07. Aluminum structural members and their connections shall be designed in accordance with AA Design Manual. Framed openings shall be designed to structurally replace the covering and framing displaced.

1.4.3 Roofing and Siding Design

Steel or aluminum roofing and siding shall be designed in accordance with MBMA Low Rise Manual.

1.4.4 Gutters And Downspouts

Gutters and downspouts shall be designed according to the requirements of

SMACNA Arch. Manual for storms which should be exceeded only once in 5 years, with adequate provision for thermal expansion and contraction.

1.5 DESIGN ANALYSIS

The Contractor shall obtain the services of a licensed Professional Engineer to design the foundations. Seismic loads shall be computed in accordance with TI 809-04 SEISMIC DESIGN FOR BUILDINGS.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weathertight coverings and kept dry. Storage accommodations for roofing and siding shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The Metal Building System (roofing, siding, and related components provided as part of the system) shall be warranted as described below against material and workmanship deficiencies, system deterioration caused by ordinary exposure to the elements and service design loads, leaks and wind uplift damage. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.7.1 Prime Contractor's Weathertightness Warranty

The Metal Building System shall be warranted by the Contractor on a no penal sum basis for a period of five years against materials and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The Metal Building System covered under this warranty shall include, but is not limited to, the following: framing and structural members, roofing and siding panels and seams, interior or exterior gutters and downspouts, accessories, fasteners, trim, flashings and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer), connectors, components, and fasteners, and other system components and assemblies installed to provide a weathertight system; and items specified in other sections of these specifications that become part of the metal building system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's written warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and/or system manufacturer, which shall be submitted along with Contractor's warranty. However, the Contractor is ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached **WARRANTY FOR METAL BUILDING SYSTEMS**, and start upon final acceptance of the facility. The Contractor shall provide a separate bond in an amount equal to the

installed total metal building system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire metal building system as outlined above.

1.7.2 Manufacturer's Materials and System Weathertightness Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties to the Contracting Officer which cover all Metal Building System components:

a. A manufacturer's 20 year material warranty warranting that the specified aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed securement system, including fasteners and coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214test procedures; or change colors in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to replacing the defective coated material.

PART 2 PRODUCTS

2.1 FRAMING AND STRUCTURAL MEMBERS

Steel 3 mm or more in thickness shall conform to ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M. Uncoated steel less than 3 mm in thickness shall conform to ASTM A 570/A 570M, ASTM A 606, or ASTM A 607. Galvanized steel shall conform to ASTM A 653/A 653M, G 90 coating designation, 1.143 mm minimum thickness. Aluminum-zinc coated steel shall conform to ASTM A 792/A 792M, AZ 55 coating designation, 1.143 mm minimum thickness. Aluminum sheet shall conform to ASTM B 209M; 0.813 mm (0.032 inch) minimum thickness. Aluminum structural shapes and tubes shall conform to ASTM B 221M, or ASTM B 308/B 308M. Structural pipe shall conform to ASTM A 53/A 53M, ASTM A 252, ASTM A 500, ASTM A 501, ASTM A 618, ASTM B 221M, ASTM B 241/B 241M or ASTM B 429. Holes for structural connections shall be made in the shop.

2.2 ROOFING AND SIDING

Roofing and siding shall be either steel or aluminum and shall have a factory color finish.

2.2.1 Roofing

Length of sheets shall be sufficient to cover the entire length of any

unbroken roof slope unless otherwise approved. Width of sheets with interlocking ribs shall provide not less than 400 mm of coverage in place. Panel shall match rof panels specified in Section 07412. Roof deck assemblies shall be Class 90 as defined in UL 580.

2.2.2 Siding

Length of sheet shall be sufficient to cover the entire height of any unbroken height of wall surface unless otherwise approved. Width of sheets with overlapping configurations shall provide not less than 610 mm of coverage in place and interlocking ribs shall provide not less than 305 mm) of coverage in place. Siding shall have configurations for overlapping adjacent sheets or interlocking ribs for securing adjacent sheets. Siding shall be fastened to framework using concealed fasteners.

2.2.3 Steel Panels

Roofing and Siding shall be zinc-coated steel conforming to ASTM A 653/A 653M, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 55 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2E5. Panels shall be 0.610 mm thick minimum.

2.2.4 NOT USED

2.2.5 NOT USED

2.2.6 Factory Color Finish

Wall and roof panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated on the drawings. The exterior coating shall be a nominal 0.025 mm thickness consisting of a topcoat of not less than 0.018 mm dry film thickness and the paint manufacturer's recommended primer of not less than 0.005 mm thickness. The interior finish shall consist of the manufacturer's recommended thickness primer coating.

2.2.7 Accessories

Flashing, trim, metal closure strips and curbs, fascia, caps, diverters, and similar metal accessories shall be the manufacturer's standard products. Exposed metal accessories shall be finished to match the building finish. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the roofing or siding and shall not absorb or retain water.

2.3 WALL LINERS

Wall liners shall be 0.6 mm thick minimum for aluminum or 0.45 mm thick minimum for steel. Matching metal trim shall be provided at base of wall liner, at top of wall liner, around openings in walls and over interior and exterior corners. Wall liners shall have manufacturer's standard finishes.

Colors shall be as indicated and specified in Section 09915 COLOR SCHEDULE.

2.4 FASTENERS

Fasteners shall be as recommended by the manufacturer to meet the design strength requirements.

2.5 WINDOWS

Windows shall be as recommended by the manufacturer; windows shall be indicated on the drawings.

2.6 DOORS

2.6.1 Hinged Doors

Hinged doors and frames shall receive a galvanic coating and factory primer and shall conform to the requirements of Section 08110 STEEL DOORS AND FRAMES. Exterior doors shall have top edges closed flush and sealed against water penetration. Hardware shall be as scheduled on the drawings and as specified in Section 08710 DOOR HARDWARE.

2.6.2 Sliding Doors

Sliding doors shall be of the metal framed or self-framing metal type. Covering shall be of same material and finish as the siding, except that heavier gauge material shall be used if required to provide rigidity. All hardware necessary for the complete installation of the doors shall be furnished. Accessories shall include galvanized steel track, brackets, permanently lubricated dual wheel trolley hangers, operating handle, slide bolt latch assembly permitting padlocking from either inside or outside of building, and rubber or elastomeric weather stripping.

2.6.3 Overhead Rolling Doors

Overhead rolling doors shall conform to the requirements of Section 08330A OVERHEAD ROLLING DOORS. Hardware shall be provided by door manufacturer.

2.7 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 24 degrees C F in accordance with ASTM C 518. Roof and wall insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Insulation including facings shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 50 when tested in accordance with ASTM E 84.

2.7.1 NOT USED

2.7.1.1 NOT USED

2.7.1.2 NOT USED

2.7.1.3 Blanket Insulation

Blanket insulation shall conform to ASTM C 553.

2.7.2 Insulation Retainers

Retainers shall be type, size and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

2.8 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubber like consistency.

2.9 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.10 VAPOR RETARDER

2.10.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 1.15 ng per Pa-second-square meter or less when tested in accordance with ASTM E 96. Facing shall be white reinforced polypropylene kraft laminate (PSK). Facings and finishes shall be factory applied.

2.11 SHOP PRIMING

Ferrous surfaces shall be cleaned of oil, grease, loose rust, loose mill scale, and other foreign substances and shop primed. Primer coating shall be in accordance with the manufacturer's standard system.

PART 3 EXECUTION

3.1 ERECTION

Dissimilar materials which are not compatible when contacting each other shall be insulated from each other by means of gaskets or insulating compounds. Improper or mislocated drill holes in panels shall be plugged with an oversize screw fastener and gasketed washer; however, panels with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces shall be kept clean and free from sealant, metal cuttings, excess material from thermal cutting, and other foreign materials. Exposed surfaces which have been thermally cut shall be finished smooth within a tolerance of 3 mm. Stained, discolored or damaged

sheets shall be removed from the site. Welding of steel shall conform to AWS D1.1; welding of aluminum shall conform to AA Design Manual.

3.1.1 Framing Members and Anchor Bolts

Onsite flame cutting of framing members, with the exception of small access holes in structural beam or column webs, will not be permitted. Concrete work is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Anchor bolts shall be accurately set by template while the concrete is in a plastic state. Members shall be accurately spaced to assure proper fitting of panels. As erection progresses, the work shall be securely fastened to resist the dead load and wind and erection stresses.

3.1.2 Roofing and Siding Installation

Siding shall be applied with the longitudinal configurations in the vertical position. Roofing shall be applied with the longitudinal configurations in the direction of the roof slope. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided where necessary to provide weathertight construction. Fastener and fastener spacing shall be in accordance with manufacture design.

3.1.3 Installation of Gutters and Downspouts

Gutters and downspouts shall be rigidly attached to the building. Spacing of cleats for gutters shall be 400 mm maximum. Spacing of brackets and spacers for gutters shall be 1 m maximum. Supports for downspouts shall be spaced according to manufacturer's recommendations.

3.1.4 NOT USED

3.1.5 Doors

Doors, including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true, and shall be adjusted as necessary to provide proper operation. Joints at doors shall be sealed according to manufacturer's recommendations to provide weathertight construction.

3.1.6 Insulation Installation

Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

3.1.6.1 Board Insulation with Blanket Insulation

Rigid or semirigid board insulation shall be laid in close contact. If more than one layer of insulation is required, joints in the second layer shall be offset from joints in the first layer.

3.1.6.2 Blanket Insulation

Blanket insulation shall be installed over the purlins and held tight

against the metal roofing. It shall be supported by an integral facing or other commercially available support system.

3.1.7 Vapor Retarder Installation

3.1.7.1 Integral Facing on Blanket Insulation

Integral facing on blanket insulation shall have the facing lapped and sealed with a compatible tape to provide a vapor tight membrane.

3.1.8 Wall Liner

Wall liner shall be securely fastened into place in accordance with the manufacturer's recommendation and in a manner to present a neat appearance.

3.2 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.3 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows shall be painted with two coats of an approved exterior enamel. Factory color finished surfaces shall be touched up as necessary with the manufacturer's recommended touch-up paint.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM

FACILITY DESCRIPTION:_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE METAL BUILDING SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY [_____] FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE AND STRUCTURAL FAILURE WITHIN PROJECT SPECIFIED DESIGN LOADS, AND LEAKAGE. THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT IS NOT LIMITED TO, THE FOLLOWING: FRAMING AND STRUCTURAL MEMBERS, ROOFING AND SIDING PANELS AND SEAMS, INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS, ACCESSORIES, TRIM, FLASHINGS AND MISCELLANEOUS BUILDING CLOSURE ITEMS SUCH AS DOORS AND WINDOWS (WHEN FURNISHED BY THE MANUFACTURER), CONNECTORS, COMPONENTS, AND FASTENERS, AND OTHER SYSTEM COMPONENTS AND ASSEMBLIES INSTALLED TO PROVIDE A WEATHERTIGHT SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS THAT BECOME PART OF THE METAL BUILDING SYSTEM. ALL MATERIAL AND WORKMANSHIP DEFICIENCIES, SYSTEM DETERIORATION CAUSED BY EXPOSURE TO THE ELEMENTS AND/OR INADEQUATE RESISTANCE TO SPECIFIED SERVICE DESIGN LOADS, WATER LEAKS AND WIND UPLIFT DAMAGE SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON [_____] AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE METAL BUILDING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL,INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE BUILDING SYSTEM DUE TO ACTIONS BY THE OWNER WHICH INHIBIT FREE DRAINAGE FROM THE ROOF, GUTTERS AND DOWNSPOUTS; OR CONDITIONS WHICH CREATE PONDING WATER ON THE ROOF OR AGAINST THE BUILDING SIDING.

6. THIS WARRANTY APPLIES TO THE METAL BUILDING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES. REPORTS OF LEAKS AND BUILDING SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(Exclusions from Coverage Continued)

IN THE CONTRACTAND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE METAL BUILDING SYSTEM REPLACED OR REPAIRED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR. IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION, UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED THE PARTIES SHALL, WITHIN 10 DAYS JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN 10 DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

SECTION 13720A

ELECTRONIC ACCESS CONTROL SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.154	(1988; R 1994) Office Machines and Supplies - Alphanumeric Machines-Keyboard Arrangement

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices
47 CFR 68	Connection of Terminal Equipment to the Telephone Network

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA-232-F	(1997) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
EIA ANSI/TIA/EIA-568-A	(1995; Addendum 3 1998) Commercial Building Telecommunications Cabling Standard

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 142	(1991) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

INTERNATIONAL TELECOMMUNICATION UNION (ITU)

ITU V.34	(1994) Data Communication Over the Telephone Network A Modem Operating at

	Data Signaling Rates of up to 28,800 bits for use on the General Switched Telephone Network and on Leased Point-to-Point Two-Wire Telephone Type Circuits
ITU V.42	(1993) Data Communications Over the Telephone Network Error-Correcting Procedures for DCEs Using Asynchronous-to-Synchronous Conversion

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 294	(1999) Access Control System Units
UL 639	(1997; Rev thru Mar 1999) Intrusion Detection Units
UL 681	(1999) Installation and Classification of Burglar and Holdup Alarm Systems
UL 796	(1999) Printed-Wiring Boards
UL 1037	(1999) Antitheft Alarms and Devices
UL 1076	(1995; Rev thru Feb 1999) Proprietary Burglar Alarm Units and Systems

1.2 SYSTEM DESCRIPTION

The Contractor shall provide an Electronic Security System (ESS) as described and shown. All computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in 47 CFR 15. Electronic equipment shall comply with 47 CFR 15.

1.2.1 Central Station (Access Control Panel)

The central station shall be configured to provide operator interface, interaction, dynamic and real time monitoring, display, and control. The central station shall control system networks to interconnect all system components including subordinate or separate control stations, enrollment stations and field equipment.

1.2.2 NOT USED

1.2.3 Field Equipment

Field equipment shall include local processors, sensors and controls. Local processors shall serve as an interface between the central station and sensors and controls. Data exchange between the central station and the local processors shall include down-line transmission of commands, software and databases to local processors. The up line data exchange from the local processor to the central station shall include status data such as intrusion alarms, status reports and entry control records. Local processors are categorized as alarm annunciation or entry control.

1.2.4 NOT USED

1.2.5 NOT USED

1.2.6 NOT USED

1.2.7 System Definitions

1.2.7.1 NOT USED

1.2.7.2 NOT USED

1.2.7.3 NOT USED

1.2.7.4 NOT USED

1.2.7.5 NOT USED

1.2.7.6 NOT USED

1.2.7.7 NOT USED

1.2.7.8 Power Loss Alarm

An alarm resulting from a loss of primary power.

1.2.7.9 Entry Control Alarm

An alarm resulting from improper use of entry control procedures or equipment.

1.2.7.10 Identifier

A card credential, keypad personal identification number or code, biometric characteristic or any other unique identification entered as data into the entry control database for the purpose of identifying an individual. Identifiers shall be used by the electronic security system for the purpose of validating passage requests for areas equipped with entry control equipment.

1.2.7.11 Entry Control Devices

Any equipment which gives a user the means to input identifier data into the entry control system for verification.

1.2.8 NOT USED

1.2.9 NOT USED

1.2.10 NOT USED

1.2.11 NOT USED

1.2.12 NOT USED

1.2.13 NOT USED

1.2.14 NOT USED

1.2.15 NOT USED

1.2.16 Power Line Surge Protection

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

1.2.17 Sensor and Device Wiring and Communication Circuit Surge Protection

Inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. Communications equipment shall be protected against surges induced on any communications circuit. Cables and conductors, except fiber optics, which serve as communications circuits from console to field equipment, and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 1 m of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 Volts and a peak current of 60 amperes.

b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 Volts and a peak current of 500 amperes.

1.2.18 NOT USED

1.2.19 System Reaction

1.2.19.1 System Response

The field device network shall provide a system end-to-end response time of 1 second or less for every device connected to the system. Alarms shall be annunciated at the central station within 1 second of the alarm occurring at a local processor or device controlled by a local processor, and within 100 milliseconds if the alarm occurs at the central station. Alarm and status changes shall be displayed within 100 milliseconds after receipt of data by the central station. All graphics shall be displayed, including graphics generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time shall be maintained during system heavy load.

1.2.20 Environmental Conditions

1.2.20.1 Interior, Controlled Environment

System components, except the console equipment installed in interior locations, having controlled environments shall be rated for continuous operation under ambient environmental conditions of 2 to 50 degrees C dry bulb and 20 to 90 percent relative humidity, non-condensing.

1.2.20.2 Interior, Uncontrolled Environment

System components installed in interior locations having uncontrolled environments shall be rated for continuous operation under ambient environmental conditions of minus 18 to plus 50 degrees C dry bulb and 10 to 95 percent relative humidity, non-condensing.

1.2.20.3 Exterior Environment

System components that are installed in locations exposed to weather shall be rated for continuous operation under ambient environmental conditions of minus 34 degrees C to 50 degrees C dry bulb and 10 to 95 percent relative humidity, condensing. In addition, the system components shall be rated for continuous operation when exposed to performance conditions as specified in UL 294 and UL 639 for outdoor use equipment. Components shall be rated for continuous operation when exposed to rain as specified in NEMA 250, winds up to 137 km per hr and snow cover up to 610 mm thick, measured vertically.

1.2.20.4 NOT USED

1.2.20.5 Console

Console equipment, unless designated otherwise, shall be rated for continuous operation under ambient environmental conditions of 16 to 29 degrees C and a relative humidity of 20 to 80 percent.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01300 Submittal Procedures:

SD-03 Product Data

Manufacturer's Data; G, RE

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

The data package shall include system descriptions, analyses, and calculations used in sizing equipment specified. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance of this specification. The data package shall include the following:

a. Central processor memory size.

b. Communication speeds and protocol descriptions.

c. Hard disk size and configuration.

d. Floppy disk size and configuration.

e. Start-up operations.

f. Expansion capability and method of implementation.

g. Sample copy of each report specified.

h. Color photographs representative of typical graphics.

Software Data

The software data package shall consist of descriptions of the operation and capability of system, and application software as specified.

SD-10 Operation and Maintenance Data

Operation and Maintenance Data; G, RE

A draft copy of the operation and maintenance manuals, as specified for the Group V technical data package, shall be delivered to the Government prior to beginning the performance verification test for use during site testing.

Hardware Manual; G, RE

A manual describing all equipment furnished including:

a. General description and specifications.

b. Installation and checkout procedures.

c. Alignment and calibration procedures.

Software Manual; G, RE

The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:

a. Definition of terms and functions.

b. Use of system and applications software.

c. Procedures for system initialization, start-up and shutdown.

d. Alarm reports.

e. Directory of all disk files.

f. Description of all communication protocols, including data formats, command characters, and a sample of each type of data transfer.

Operator's Manual; G, RE

The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:

a. Computers and peripherals.

b. System start-up and shutdown procedures.

c. Use of system, and applications software.

d. Recovery and restart procedures.

e. Data entry.

f. Operator commands.

g. Alarm and system messages and printing formats.

h. System entry requirements.

Maintenance Manual; G, RE

The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.3.1 [Enter Appropriate Subpart Title Here]1.4 TESTING

1.4.1 General

The Contractor shall perform pre-delivery testing, site testing, and adjustment of the completed ESS. The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test; notice shall not be given until after the Contractor has received written approval of the specific test procedures.

1.4.2 Test Procedures and Reports

Test procedures shall explain in detail, step-by-step actions and expected results, demonstrating compliance with the requirements specified. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

PART 2 PRODUCTS

2.1 MATERIALS REQUIREMENTS

2.1.1 Materials and Equipment

Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's model and serial number in a conspicuous place. System equipment shall conform to UL 294 and UL 1076.

2.1.2 Field Enclosures

2.1.2.1 NOT USED

2.1.2.2 NOT USED

2.1.2.3 Interior Electronics

System electronics to be used in an interior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 12.

2.1.2.4 Exterior Electronics

System electronics to be used in an exterior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 4X.

2.1.2.5 Corrosion Resistant

System electronics to be used in a corrosive environment as defined in NEMA 250 shall be housed in metallic enclosures which meet the requirements of NEMA 250 Type 4X.

2.1.3 Nameplates

Laminated plastic nameplates shall be provided for local processors. Each nameplate shall identify the local processor and its location within the system. Laminated plastic shall be 3 mm thick, white with black center core. Nameplates shall be a minimum of 25 x 75 mm, with minimum 6 mm

high engraved block lettering. Nameplates shall be attached to the inside of the enclosure housing the local processor. Other major components of the system shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a corrosion resistant plate secured to the item of equipment. Nameplates will not be required for devices smaller than 25 x 75 mm.

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 Locks and Key-Lock Switches

2.1.6.1 Locks

Locks shall be provided on system enclosures for maintenance purposes. Locks shall be UL listed, round-key type with 3 dual, 1 mushroom, 3 plain pin tumblers or conventional key type lock having a combination of 5 cylinder pin and 5-point 3 position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." The locks shall be arranged so that the key can only be withdrawn when in the locked position. Maintenance locks shall be keyed alike and only 2 keys shall be furnished for all of these locks. These keys shall be controlled in accordance with the key control plan as specified in paragraph Key Control Plan.

2.1.7 System Components

System components shall be designed for continuous operation. Electronic components shall be solid state type, mounted on printed circuit boards conforming to UL 796. Printed circuit board connectors shall be plug-in, quick-disconnect type. Power dissipating components shall incorporate safety margins of not less that 25 percent with respect to dissipation ratings, maximum voltages, and current carrying capacity. Control relays and similar switching devices shall be solid state type or sealed electro-mechanical.

2.1.7.1 Modularity

Equipment shall be designed for increase of system capability by installation of modular components. System components shall be designed to facilitate maintenance through replacement of modular subassemblies and parts.

2.1.7.2 Maintainability

Components shall be designed to be maintained using commercially available tools and equipment. Components shall be arranged and assembled so they are accessible to maintenance personnel. There shall be no degradation in tamper protection, structural integrity, EMI/RFI attenuation, or line supervision after maintenance when it is performed in accordance with manufacturer's instructions. The system shall be configured and installed to yield a mean time to repair (MTTR) of not more than 8 hours. Repair time is the clock time from when maintenance personnel gain entrance to the system and begin work, until the system is fully functional.

2.1.7.3 Interchangeability

The system shall be constructed with off-the-shelf components which are physically, electrically and functionally interchangeable with equivalent components as complete items. Replacement of equivalent components shall not require modification of either the new component or of other components with which the replacement items are used. Custom designed or one-of-a-kind items shall not be used. Interchangeable components or modules shall not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

2.1.7.4 Product Safety

System components shall conform to applicable rules and requirements of NFPA 70 and UL 294. System components shall be equipped with instruction plates including warnings and cautions describing physical safety, and special or important procedures to be followed in operating and servicing system equipment.

2.1.8 Controls and Designations

Controls and designations shall be as specified in NEMA ICS 1.

2.1.9 Special Test Equipment

The Contractor shall provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.1.10 Alarm Output

The alarm output of each sensor shall be a single pole double throw (SPDT) contact rated for a minimum of 0.25 A at 24 Volts dc.

2.2 CENTRAL STATION HARDWARE

The central station computer shall be a standard unmodified digital computer of modular design. The CPU word size shall be 64 bits or larger. The operating speed of the processor shall be at least 150 MHZ.

2.2.1 Memory

The computer shall contain at least 32 megabytes of usable installed memory, expandable to a minimum of 256 megabytes without additional chassis or power supplies.

2.2.2 Power Supply

The power supply shall have a minimum capacity of 250 Watts.

2.2.3 Real Time Clock (RTC)

A RTC shall be provided. Accuracy shall be within plus or minus 1 minute per month. The RTC shall maintain time in a 24-hour format including seconds, minutes, hours, date, and month and shall be resettable by software. The clock shall continue to function for a period of 1 year without power.

2.2.4 Serial Ports

a. Two EIA ANSI/EIA/TIA-232-F serial ports shall be provided for general use.

b. Adjustable data transmission rates from 9600 to 57.6 Kbps shall be selectable under program control.

c. Sixteen additional EIA ANSI/EIA/TIA-232-F serial ports shall be provided as part of a communications coprocessor. The coprocessor word size shall be 32 bytes or larger and the operating speed of the coprocessor shall be at least 66 MHZ. Communications with the field equipment shall be managed by this device. Multiplexed serial ports shall be expandable to 48 ports with 8 character transmit and receive buffers to each port. Total buffer size shall be a minimum of 1 megabyte.

2.2.5 Parallel Port

An enhanced parallel port shall be provided.

2.2.6 Color Monitor

The monitor shall be no less than 430 mm, with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28 millimeters. The video card shall support at least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70 Hz.

2.2.7 Keyboard A101

A keyboard having a minimum 64 character, standard ASCII character, based on ANSI X3.154 shall be furnished.

2.2.8 NOT USED

2.2.9 NOT USED

2.2.10 Floppy Disk Drives

A high density floppy disk drive and controller in 90 mm size shall be provided.

2.2.11 NOT USED

2.2.12 Modem

A modem shall be provided and operate at 28,800 bps, full duplex on

circuits using asynchronous communications. Modem shall have error detection, auto answer/autodial, and call-in-progress detection. The modem shall meet the requirements of ITU V.34, ITU V.42 for error correction and ITU V.42 for data compression standards, and shall be suitable for operating on unconditioned voice grade telephone lines in conformance with 47 CFR 68.

2.2.13 Audible Alarm

The manufacturer's standard audible alarm shall be provided.

2.2.14 Mouse

A mouse with a minimum resolution of 400 dots per inch shall be provided.

2.2.15 CD-ROM Drive

A CD-ROM drive having a nominal storage capacity of 650 megabytes shall be provided. The CD-ROM drive shall have the following minimum characteristics:

a. Data Transfer Rate: 1.2 Mbps.

b. Average Access Time: 150 milliseconds.

c. Cache memory: 256 Kbytes.

d. Data throughput: 1 Mbyte/second, minimum.

2.2.16 Dot Matrix Alarm Printer

A dot matrix alarm printer shall be provided and interconnected to the central station equipment. The dot matrix alarm printer shall have a minimum 96 character, standard ASCII character set, based on ANSI X3.154 and with graphics capability. The printer shall be able to print in both red and black without ribbon change. The printers shall have adjustable sprockets for paper width up to 11 inches, print at least 80 columns per line and have a minimum speed of 200 characters per second. Character spacing shall be selectable at 10, 12 or 17 characters per inch. The printers shall utilize sprocket-fed fan fold paper. The units shall have programmable control of top-of-form. Twenty-five thousand sheets of printer paper and 12 ribbons shall be provided after successful completion of the endurance test.

2.2.17 NOT USED

2.2.18 NOT USED

2.2.19 NOT USED

2.2.20 NOT USED

2.2.21 Uninterruptible Power Supply (UPS)

A self contained UPS, suitable for installation and operation at the central station, shall be provided. The UPS shall be sized to provide a minimum of 6 hours of operation of the central station equipment. Equipment connected to the UPS shall not be affected by a power outage of a duration less than the rated capacity of the UPS. UPS shall be complete with necessary power supplies, transformers, batteries, and accessories and shall include visual indication of normal power operation, UPS operation, abnormal operation and visual and audible indication of low battery power. The UPS condition shall be monitored by the ESS and displayed at the Central Station.

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 INTERIOR SENSORS AND CONTROL DEVICES

2.6.1 Balanced Magnetic Switch (BMS)

The BMS shall detect a 6 mm of separating relative movement between the magnet and the switch housing. Upon detecting such movement, the BMS shall transmit an alarm signal to the alarm annunciation system.

2.6.1.1 BMS Subassemblies

The BMS shall consist of a switch assembly and an actuating magnet assembly. The switch mechanism shall be of the balanced magnetic type. Each switch shall be provided with an overcurrent protective device, rated to limit current to 80 percent of the switch capacity. Switches shall be rated for a minimum lifetime of 1,000,000 operations. The magnet assembly shall house the actuating magnet.

2.6.1.2 Housing

The housings of surface mounted switches and magnets shall be made of nonferrous metal and shall be weatherproof. The housings of recess mounted switches and magnets shall be made of nonferrous metal or plastic.

2.7 NOT USED

2.8 ENTRY CONTROL DEVICES

2.8.1 Card Readers and Credential Cards

Entry control card readers shall use unique coded data stored in or on a compatible credential card as an identifier. The card readers shall be proximity type, and shall incorporate built-in heaters or other cold weather equipment to extend the operating temperature range as needed for operation at the site. Communications protocol shall be compatible with the local processor. The Contractor shall furnish card readers to read proximity detection entry cards, and the matching credential cards. The cards shall contain coded data arranged as a unique identification code

stored on or within the card, and of the type readable by the card readers. The Contractor shall include within the card's encoded data, a non-duplicated unique facility identification code common to all credential cards provided at the site. Enrollment equipment to support local encoding of badges including cryptographic and other internal security checks shall be supplied.

2.8.1.1 NOT USED

2.8.1.2 NOT USED

2.8.1.3 Proximity

Proximity card readers shall use active proximity detection and shall not require contact with the proximity credential card for proper operation. Active detection proximity card readers shall provide power to compatible credential cards through magnetic induction and receive and decode a unique identification code number transmitted from the credential card. The card reader shall read proximity cards in a range from 0 mm to at least 150 mm from the reader. The credential card design shall allow for a minimum of 32,000 unique identification codes per facility.

2.8.1.4 Card Reader Display

The card readers shall include an LED or other visual indicator display. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected.

2.8.1.5 Card Reader Response Time

The card reader shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less, from the time the card reader finishes reading the credential card until a response signal is generated.

2.8.1.6 Card Reader Power

The card reader shall be powered from the source as shown and shall not dissipate more than 5 Watts.

2.8.1.7 Card Reader Mounting Method

Card readers shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

2.8.1.8 Credential Card Modification

Entry control cards shall be able to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge as needed for the site without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type badge holder used at the site.

2.8.1.9 Card Size and Dimensional Stability

Credential cards shall be 54 x 85 mm (2-1/8 x 3-3/8 inches) mm. The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

2.8.1.10 Card Materials and Physical Characteristics

The credential card shall be abrasion resistant, non-flammable, and present no toxic hazard to humans when used in accordance with manufacturer's instructions. The credential card shall be impervious to solar radiation and the effects of ultra-violet light.

2.8.1.11 Card Construction

The credential card shall be of core and laminate or monolithic construction. Lettering, logos and other markings shall be hot stamped into the credential material or direct printed.

2.8.1.12 Card Durability and Maintainability

The credential cards shall be designed and constructed to yield a useful lifetime of at least 5000 insertions or swipes or 5 years whichever results in a longer period of time. The credential card shall be able to be cleaned by wiping the credential card with a sponge or cloth wet with a soap and water solution.

2.8.2 NOT USED

2.8.3 NOT USED

2.8.4 NOT USED

2.8.5 Portal Control Devices

2.8.5.1 Push-button Switches

The Contractor shall provide momentary contact, back lighted push buttons and stainless steel switch enclosures for each push button as shown. Switch enclosures shall be suitable for flush, or surface mounting as required. Push buttons shall be suitable for flush mount in the switch enclosures. The push button switches shall meet the requirements of NEMA 250 for the area in which they are to be installed. Where multiple push buttons are housed within a single switch enclosure they shall be stacked vertically with each push button switch labeled with 7 mm high text and symbols as required. The push button switches shall be connected to the local processor associated with the portal to which they are applied and shall operate the appropriate electric strike, electric bolt or other facility release device.

2.8.5.2 NOT USED

2.8.5.3 NOT USED

2.8.5.4 Electromagnetic Lock

Electromagnetic locks shall contain no moving parts and shall depend solely upon electromagnetism to secure a portal by generating at least 5.3 kN of holding force. The electromagnetic lock shall release automatically in case of power failure and shall require manual reset to resume normal function. The lock shall interface with the local processors without external, internal or functional alteration of the local processor. The electromagnetic lock shall incorporate an end of line resistor to facilitate line supervision by the system.

a. Armature: The electromagnetic lock shall contain internal circuitry to eliminate residual magnetism and inductive kickback. The actuating armature shall operate on 12 or 24 Volts dc and shall not dissipate more than 12 Watts. The holding current shall be not greater than 500 milliamperes. The actuating armature shall take not more than 300 milliseconds to change the status of the lock from fully secure to fully open or fully open to fully secure.

b. Tamper Resistance: The electromagnetic lock mechanism shall be encased in hardened guard barriers to deter forced entry.

c. Mounting Method: The door electromagnetic lock shall be suitable for use with single and double door with mortise or rim type hardware as shown, and shall be compatible with right or left hand mounting.

2.8.5.5 NOT USED

2.8.5.6 NOT USED

2.8.5.7 NOT USED

2.8.5.8 Vehicle Gate Opener

The vehicle gate shall include housing, mounting hardware, electrical wiring, and appurtenances as required. The vehicle gate openers shall be suitable for connection to, and monitoring and control by the system local processors. A hand crank for manual operation of the vehicle gate opener and a solenoid actuated brake to prevent gate coasting shall be provided. The vehicle gate opener shall provide an auto reverse time delay of at least 1 second and not more than 3 seconds to minimize shock loads on vehicle gate opener drive components. The vehicle gate opener shall include a contactor type motor starter which meets or exceeds NEMA size "O" specifications.

a. Input Power: The vehicle gate opener shall operate from the voltage source shown. The vehicle gate opener shall include manual reset type thermal and electrical overload devices.

b. Audible Warning: The vehicle gate opener shall have an audible warning system to signal personnel in the vicinity of the vehicle gate opener that an opening or closing is about to commence. The audible shall

sound at least 2 seconds and no more than 5 seconds before movement begins.

c. Maximum Run Timer: The vehicle gate opener shall incorporate an internal maximum run timer which limits the motor run time. The maximum run time shall be operator adjustable for at least the maximum amount of time gate opening or closing takes during normal operation.

d. Adjustable Load Monitor for Obstruction Sensing: The vehicle gate opener shall have an operator adjustable load monitor that shall sense obstructions in the path of the gate and automatically reverse the vehicle gate opener drive motor.

e. Operator Override Controls: The vehicle gate opener shall interface to a 3 push-button control station located within an entry controlled area. The 3 push-button switches shall be labeled and function as open, close, and stop controls, and shall meet the requirements of paragraph Push-button Switches.

f. Limit Switches: The vehicle gate opener shall have adjustable limit switches and shall provide a means to securely lock the switches in place after adjustment. The range of gate travel shall be defined by the location of the limit switches.

g. Type of Gate: The vehicle gate openers provided shall be compatible with cantilever, roller, v-track, overhead, slide, and swing gates.

2.9 NOT USED

2.10 ENTRY CONTROL SOFTWARE

2.10.1 Interface Device

The entry control software shall control passage. The decision to grant or deny passage shall be based upon identifier data to be input at a specific location. If all conditions are met, a signal shall be sent to the input device location to activate the appropriate electric strike, bolt, electromagnetic lock or other type of portal release or facility interface device.

2.10.2 Operator Interface

Entry control operation shall be entirely automatic under control of the central station and local processors except for simple operations required for map display, alarm acknowledgment, zone and portal status change operations, audible or visual alarm silencing and audio annunciation. The system shall immediately annunciate changes in zone and portal status. The alarm printer shall print a permanent record of each alarm and status change. The map displays or graphics screens shall display the current status of system zones and portals. The central station shall immediately display the current status of any zone or portal upon command. While the system is annunciating an unacknowledged zone or portal alarm, keyboard operations at the central station, other than alarm acknowledgment, shall not be possible. The system shall provide the capability to change zone

and portal status from alarm (after alarm acknowledgment) or access to secure; from alarm (after alarm acknowledgment) or secure to access, or from access to secure by simple control operations. If the operator attempts to change zone status to secure while there is an alarm output for that zone or portal, the system shall immediately annunciate an alarm for that zone or portal.

2.10.3 Entry Control Functions

2.10.3.1 Multiple Security Levels

The system shall have multiple security levels. Each of the security levels shall be delineated by facility barriers. Access to each security level shall be through portals in the facility barriers using designated entry control procedures. The system shall provide at least 8 security levels. Any attempt to access an area beyond an individual's security level shall initiate an access denial alarm.

2.10.3.2 Two person rule

The system shall provide a 2 person rule feature. When a portal is designated as a 2 person rule portal, it shall not allow passage unless 2 valid identifiers are presented in the proper sequence. The scheme shall be designed so that only the first 2 valid identifiers and the last 2 valid identifiers pass together.

2.10.3.3 NOT USED

2.10.3.4 Immediate Access Change

The system shall provide functions to disenroll and deny access to any identifier or combination of identifiers without consent of the individual or recovery of a credential. The design of the system shall provide entry change capability to system operators and managers with appropriate passwords at the system operator or enrollment consoles.

2.10.3.5 Multiple Time Zones

The system shall provide multiple time zone entry control. Personnel enrolled in the system shall only be allowed access to a facility during the time of day they are authorized to access the facility. Time zone access control shall also include the ability to specify beginning and ending dates that an individual will be authorized to access a facility. The system shall provide automatic activation and deactivation of entry authorization. The design of the system shall provide at least 2 time zones with overlapping time zones. The system shall provide a means for system operators with proper password clearance, to define custom names for each time zone, and to change the time zone's beginning and ending times through the system operator and enrollment interfaces. The system shall automatically disenroll individuals at the end of their predefined facility access duration. Any attempt during a 24 hour period by an individual or an identifier to gain facility entry outside of the authorized time zone shall initiate an entry denial alarm.

2.10.4 Electronic Entry Control System Capacities

The system shall be designed and configured to provide the following capacities.

2.10.4.1 NOT USED

2.10.4.2 Transaction History File Size

The system capacity shall be at least the amount of transactions for the system during 1 year without any loss of transaction data.

2.10.5 Entry Control System Alarms

The system shall annunciate an alarm when the following conditions occur. Alarms shall be annunciated at the console both audibly and visually. An alarm report shall also be printed on the system printer. The alarm annunciation shall continue until acknowledged by the system operator. Only 1 control key shall be needed to acknowledge an alarm. The system shall control, monitor, differentiate, rank, annunciate, and allow operators to acknowledge, in real time, alarm signals generated by system equipment. The system shall also provide a means to define and customize the annunciation of each alarm type. The system shall use audio and visual information to differentiate the various types of alarms. Each alarm type shall be assigned an audio and a unique visual identifier.

2.10.5.1 NOT USED

2.10.5.2 NOT USED

2.10.5.3 Entry Denial

The system shall annunciate an alarm when an attempt has been made to pass through a controlled portal and entry has been denied.

2.10.5.4 Portal Open

The system shall annunciate an alarm when an entry controlled portal has been open longer than a predefined time delay. The time delay shall be adjustable, under operator control, over a range of at least 1 second to 1 minute with a maximum resolution of 1 second.

2.10.5.5 Bolt Not Engaged

The system shall annunciate an alarm when the bolt at an entry controlled portal has been open longer than a predefined time delay and generate an entry control alarm. The time delay shall be adjustable, under operator control, over a range of at least 1 second to 1 minute with a maximum resolution of 1 second.

2.10.5.6 Strike Not Secured

The system shall annunciate an alarm when the strike at an entry controlled portal has been left unsecured longer than a predefined time delay and

generate an entry control alarm. The time delay shall be adjustable, under operator control, over a range of at least 1 second to 1 minute with a maximum resolution of 1 second.

2.10.5.7 Alarm Shunting/System Bypass

The system shall provide a means to ignore operator selected alarm types at operator selected portals in order to allow standard entry control procedures to be bypassed (shunted). Predefined alarm shunting shall only be available to system operators with the proper password. The system shall also provide for predefined alarm shunting based upon time zones. This capability shall only apply to the entry control alarm type.

2.11 WIRE AND CABLE

The Contractor shall provide all wire and cable. Wiring shall meet NFPA 70 standards.

2.11.1 NOT USED

2.11.2 NOT USED

2.11.3 Local Area Network (LAN) Cabling

LAN cabling shall be in accordance with EIA ANSI/TIA/EIA-568-A, category 6.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor shall install all system components, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown. The contractor shall furnish necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.1.1 Installation

The contractor shall install the system in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate service points to pinpoint system trouble in less than 20 minutes. Minimum size of conduit shall be 15 mm. DTS shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. Flexible cords or cord connections shall not be used to supply power to any components of the system, except where specifically noted.

3.1.2 Enclosure Penetrations

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior

enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable.

3.1.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc., shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.4 NOT USED

3.1.5 NOT USED

3.1.6 Installation Software

The Contractor shall load software as specified and required for an operational system, including data bases and specified programs. Upon successful completion of the endurance test, the Contractor shall provide original and backup copies on CD-ROM of all accepted software, including diagnostics.

3.2 SYSTEM STARTUP

Satisfaction of the requirements below does not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment. The Contractor shall not apply power to the system until after:

a. System equipment items and DTS have been set up in accordance with manufacturer's instructions.

b. A visual inspection of the system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

c. System wiring has been tested and verified as correctly connected.

d. System grounding and transient protection systems have been verified as properly installed.

e. Power supplies to be connected to the system have been verified as the correct voltage, phasing, and frequency.

3.3 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed system; and are approved by the Contracting Officer. These representatives shall be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These

representatives shall also be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives shall participate in the testing and validation of the system and shall provide certification that their respective system portions meet the contractual requirements.

3.4 TESTING

3.4.1 General Requirements for Testing

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. The Government will witness all performance verification and endurance testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during predelivery, performance verification and endurance testing, shall be turned over to the Government at the conclusion of each phase of testing, prior to Government approval of the test.

3.4.2 Predelivery Testing

The Contractor shall assemble the test system as specified, and perform tests to demonstrate that performance of the system complies with specified requirements in accordance with the approved predelivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced during predelivery testing, including results of each test procedure, shall be delivered to the Government at the conclusion of predelivery testing, prior to Government approval of the test. The test report shall be arranged so that all commands, stimuli, and responses are correlated to allow logical interpretation.

3.4.3 Test Setup

The predelivery test setup shall include the following:

a. All central station equipment.

b. At least 1 of each type DTS link, but not less than 2 links, and associated equipment to provide a fully integrated system.

c. The number of local processors shall equal the amount required by the site design.

d. At least 1 of each type sensor used.

e. Enough sensor simulators to provide alarm signal inputs to the system equal to the number of sensors required by the design. The alarm signals shall be manually or software generated.

f. At least 1 of each type of terminal device used.

g. At least 1 of each type of portal configuration with all facility

interface devices as specified or shown.

h. The Contractor shall prepare test procedures and reports for the predelivery test, and shall deliver the predelivery test procedures to the Government for approval. The final predelivery test report shall be delivered after completion of the predelivery test.

3.4.4 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify DTS operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations, including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

3.4.5 Performance Verification Test

The Contractor shall demonstrate that the completed system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until after receipt by the Contractor of written permission from the Government, based on the Contractor's written report. The report shall include certification of successful completion of testing as specified in paragraph Contractor's Field Testing, and upon successful completion of training as specified. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to commencing the endurance test.

3.4.6 Endurance Test

a. General: The Contractor shall demonstrate system reliability and operability at the specified throughput rates for each portal, and the Type I and Type II error rates specified for the completed system. The contractor shall calculate false alarm rates and the system shall yield false alarm rates within the specified maximums at the specified probability of detection. The endurance test shall be conducted in phases as specified. The endurance test shall not be started until the Government notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. The Contractor shall provide 1 operator to operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing, in addition to any Government personnel that may be made available. The Government may terminate testing at any time the system fails to perform as specified. Upon termination of testing by the

Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. The Contractor shall verify the operation of each terminal device during the last day of the test. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

b. Phase I Testing: The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing. If the system experiences no failures during Phase I testing, the Contractor may proceed directly to Phase III testing after receipt by the Contractor of written permission from the Government.

c. Phase II Assessment: After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, or may require that Phase I be repeated. If the retest is completed without any failures, the Contractor may proceed directly to Phase III testing after receipt by the Contractor of written permission from the Government.

d. Phase III Testing: The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

e. Phase IV Assessment: After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, and may require that Phase III be repeated. The Contractor shall not commence any required retesting until after receipt of written notification by Government. After the conclusion of any

retesting which the Government may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

f. Exclusions: The Contractor will not be held responsible for failures in system performance resulting from the following:

(1) An outage of the main power in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the ESS performed as specified.

(2) Failure of a Government furnished communications circuit, provided that the failure was not due to Contractor furnished equipment, installation, or software.

(3) The occurrence of specified nuisance alarms.

(4) The occurrence of specified environmental alarms.

3.5 RELIABILITY CALCULATION

This exponential calculation depends on the test duration and assumes that the Mean Time Between Failures (MTBF) does not change after each repair; and that the probability of failure is constant throughout the useful life of the component regardless of how many failures the system has experienced. This calculation does not account for effects of aging.

3.5.1 Definition of Reliability

System reliability is calculated in terms of overall MTBF where the component reliability furnished by vendors is already expressed as MTBF. The mathematical combination of the component MTBF values is defined as the system reliability, R(t); the probability that the system will perform its function during a given time period under specified conditions. In this calculation, each component reliability is determined; the component reliabilities are combined as dictated by the system configuration; and the overall MTBF is computed as follows:

R(t) = e(-t/MTBF); where:

MTBF = mean time between failure

t = duration of test period

e = base of natural logarithms

When t/MTBF is less than 0.1, the reliability can be approximated as follows:

R(t) = 1 - (t/MTBF): A specific reliability value can be interpreted by noting that a value of R(t) greater than 1/e (which equals 0.37) indicates that the MTBF value is greater than the test duration.

3.5.2 Series and Parallel Components

Components are in series if failure of 1 component causes a system failure. Reliability of components in series is a product of the individual reliabilities:

R = 1 - (r1)(r2)(r3)...(rn). If components in a system are redundant (parallel), reliability is computed as follows:

R = 1 - {(1-r1)(1-r2)...(1-rn)}. If a system has parallel components, an equivalent series reliability is computed for each set of parallel components. The reliability of the system is then computed as the product of series and equivalent series reliabilities.

3.5.3 Calculation Procedure

The Contractor shall prepare a table showing the following data:

a. Name and quantity of each component.

b. Each component identified as series or parallel. (For example, if there are 2 printers, the failure of 1 will not cause a system failure).

c. MTBF for each component.

d. Single unit reliability: R = e(-t/MTBF), where t = 1,000 hour test period.

e. Total Component Reliability (TCR) where TCR = Rn, and n = number of components. For parallel components, TCR = 1 - (1-R)n, where n = number of components.

f. Cumulative Reliability (CUMR) is the product of total component reliability; for example: CUMR 4 = (TCR1) (TCR2) (TCR3) (TCR4) = (CUMR3) (TCR4)

g. Cumulative MTBF = -1,000/LN (CUMR); where LN (CUMR) is the natural logarithm of (CUMR). As an example: CUM.MTBF = -1,000/LN (CUMR4)

3.5.4 Sample Calculations

MTBF is not calculated for sensors and controls. Input/Output functions are part of the local processor. Any Input/Output failure not attributable to sensors and controls constitutes a local processor failure and is thus reflected in the local processor MTBF. MTBF for other components are based on the lowest values provided by vendors. The calculation shall be based on the following configuration:

a. All central station equipment.

b. Data Transmission System (DTS) equipment associated with one DTS circuit, but excluding the circuit itself.

c. Sixteen local processors with all the functions as specified in paragraph Local Processor.

d. Four representative types of devices, per local processor.

-- End of Section --

SECTION 13851

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41	(1990; R 1996) Audible Emergency Evacuation Signals

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15	Radio Frequency Devices

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 72	(1996; Errata Oct 96, Dec 96; TIA 96-1, 96-2, 96-3) National Fire Alarm Code
NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems
NFPA 1221	(1994) Installation, Maintenance and Use of Public Fire Service Communication Systems

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 38	(1994; Rev Nov 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 268	(1996; Rev thru Jun 1998) Smoke Detectors for Fire Protective Signaling Systems

UL 268A	(1998) Smoke Detectors for Duct Applications
UL 464	(1996; Rev May 1997) Audible Signal Appliances
UL 521	(1993; Rev Oct 1994) Heat Detectors for Fire Protective Signaling Systems
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996) Control Units for Fire-Protective Signaling Systems
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1971	(1995; Rev thru May 1997) Signaling Devices for the Hearing Impaired

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System; G, AE

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

Detailed fire alarm system drawings shall also include a

complete fire alarm system riser diagram showing all equipment, devices and wiring. All equipment, devices, control and monitor modules, etc. shall include; corresponding zone number, unique assigned device number, and room location number. Riser wiring to show wire gauge size and type. Identify all NAC circuits, SLC circuits, and IDC circuits by NFPA circuit type styles and assigned ID numbers.

SD-03 Product Data

Storage Batteries; G, RE

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop

Voltage drop calculations for notification appliance circuits and initiating device circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G, RE

Technical data which relates to computer software. All software and software changes or operation changes needed to make the fire alarm system complete and functional shall be reviewed and approved by the qualified fire protection engineer. Software includes all system programming as necessary for the new building systems fire alarm equipment and the existing GH. Harlow head-end signal receiving equipment located in Main Fire Station Building 1518.

Training

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Fire Alarm Test Plan; G, RE

G-RE Fire alarm test plan shall be approved 90 days prior to performing system tests. The test plan shall be organized by specific subsystems and signed by a registered professional engineer or a NICET Level 4 Technician that it has been reviewed and complies with specified criteria. The fire alarm test plan shall consist of a system inspection and readiness checklist, detailed step-by-step test procedures which include all specified performance criteria, coded ID device-by-device test results data sheets, corresponding coded ID device system layout drawings, NFPA 72 Certificate of Completion, and the NFPA 72 Inspection and Testing Forms used as guidelines and adapted as necessary for site specific installed fire alarm system. Sound level measurement data shall include: annunciation device output decibel (dB) readings measured 10' from the device, general alarm dB sound readings of the entire facility (all corridors, rooms, etc.) identified by corridor & room number, room ambient sound level measurements, and required general alarm sound level reading (the greater of 65 dB or 15 dB above ambient) with pass/fail noted. All doors to be closed when taking sound level measurements. Sound level measurements to be taken using the A-weighted scale. The test plan shall be in a hardbound cover identifying: the project name, location, date of submittal, name of the Contractor, and a general title indicating the specific area and type of work. Test plan to include proposed schedule for the testing of the complete fire alarm system; list of qualified manpower needed to perform the testing, list of equipment to be used to perform testing. Test result data sheets to include: date of testing, whom performed the test, whom witnessed the testing and document all major corrective action taken.

SD-06 Test Reports

Testing

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the approved Fire Alarm Test Plan's detailed test procedures, all associated completed coded data sheets, all system and subsystem corresponding coded as-built system layout and riser drawings, and the NFPA 72 Inspection and Testing Forms.

SD-07 Certificates

Equipment; G, RE

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications; G, RE

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G, RE

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Provide copies of the fire alarm panel's programming on paper, CD-ROM and two copies on 90-mm diskettes. Manuals shall be approved 14 days prior to training. O & M Manual shall also include the approved Fire Alarm Test Plan's detailed test procedures, all associated completed coded data sheets, all system and subsystem corresponding coded as-built system layout and riser drawings, and the contractor signed NFPA 72 Certificate of Completion.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 4 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

a. An engineer having a Bachelor of Science or Masters of Science

Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. Alarm and supervisory initiating devices shall be individually addressable. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm and supervisory initiating devices shall be connected to initiating device circuits (IDC), Style D. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

a. Sufficient memory to perform as specified and as shown for addressable system.

b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors

c. Capability of each addressable device being individually disabled or enabled from the panel.

d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

1.4.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of SLC, and NAC.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.

f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.

g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 1 second. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or

verification.

i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.

j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall and shutdown in accordance with NFPA 72, and NFPA 101.

l. The fire alarm control panel shall monitor the fire sprinkler system, or other fire protection extinguishing system.

m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

n. Operation of a flow switch in the elevator machine room shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.

1. A field-mounted relay actuated by the flow switch or the FACP closes the shunt trip circuit and operates building notification appliances and remote annunciator.

o. The fire alarm panel and battery back-up system shall be sized wire 25% spare capacity. The spare capacity shall be figured into all the components/systems of the fire alarm/detection system including, but not limited to: (battery size, wire size, quantity of cords, cabinet size, etc.)

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of a signal over the station radio fire reporting system. The signal shall be common for any device.

b. Visual indications of the alarmed devices on the fire alarm control panel display and on the remote audible/visual display if one is provided (refer to plans).

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.

d. Deactivation of the air handling units throughout the building.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.4.6 NOT USED

1.4.7 Interface With other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

(1) Identification of programmable portions of system equipment and capabilities.

(2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

(3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

(4) Description of Fire Alarm Control Panel equipment operation.

(5) Description of auxiliary and remote equipment operations.

(6) Library of application software.

(7) Operation and maintenance manuals as specified in SD-10 of the Submittals paragraph.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface-mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

2.1.1 Remote Audible/Visual Graphics Annunciator Display

Graphic annunciator shall be alphanumeric and have a plan view of each floor and indicate the building floor plan with a "You are Here" designation. Provide an LED-indicating light on the floor plan for each addressed device. Provide lights that indicate the floor on which a signal was actuated. Engrave device and floor designations on the face of annunciator. Indicating lights include individual LED indicators for each type of alarm and supervisory device and an LED to indicate trouble. The actuation of any alarm or supervisory signal causes the illumination of a NAC zone light, floor light, and device light, and device light system trouble cause the illumination of all these lights and also the trouble light. Additional LED's indicate normal and emergency power modes for the

system. Lamps shall be red for alarm condition, blue or green for supervisory condition, and amber for trouble condition. Plan views shall be approximately to scale and in case smaller than 400 mm in length or with. Annunciator shall have a door with piano hinge and two-point cylinder lock or two cylinder locks. Lock shall be operable using the same key as the control panel. Annunciator shall contain a lamp test switch, audible trouble signal and a trouble switch to silence the audible alarm, but not extinguish the trouble lamp. Annunciator shall be flush mounted. Faceplate or graphic annunciator shall be as follows: finished stainless steel or brushed aluminum. Floor plan and zone boundary lines are engraved in the faceplate and filled with colored paint. Floor plan lines are 6 mm with black and device designations are 3 mm wide red. Engraved legends for the LEDs and switches are 1/4 inch high minimum, engraved letter filled with red paint. The remote LED/LCD visual display shall provide minimum of 168 character identification, consisting of word description of device and ID number with zone number for each device as displayed on the central fire alarm control panel.

2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.1.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled. All addressable control modules shall be labeled to their unique assigned device ID number and associated Zone 10 number. Labels shall be placed on the exterior of device and be readable for use during fire alarm testing.

2.1.5 Addressable Initiating Device Circuit Modules

Require the initiating devices being monitored to be configured as "Style D" and add to the end of the paragraph the following sentences. "All addressable initiating device circuits modules shall be labeled with their unique assigned device ID No. and associated zoned ID No. Labels shall be

placed on the exterior of device and be readable for using during fire alarm testing."

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel or in a separate battery cabinet. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

2.3 BATTERY CHARGER

Battery charger shall be UL listed for fire alarm applications, have low voltage supervision feature and completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 1220 mm. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Addressable manual fire alarm pull stations shall be labeled on the outside face of the device with it's fire zone and unique device number. Labeled device number shall match the fire alarm panel and remote LCD readouts.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making

connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed. Fire detecting devices shall not be installed until construction dust has been removed from the entire facility. All alarm initiating devices shall be individually addressable and report back to fire alarm panel, and remote annunciator with their unique address, room location and corresponding fire alarm zone shown on the graphic annunciator. Addressable fire detecting devices shall be labeled on the outside face of the device and as applicable its' corresponding remote indicator. Label to include device's fire zone and unique device number and shall match the fire alarm panel and remote LCD readouts.

2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as defined by NFPA 70 and as shown on drawings, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated. Addressable heat detector devices shall be labeled on the outside face of the device and as applicable its' corresponding remote indicator. Label to include device's fire zone and unique device no. and shall match the fire alarm panel and remote LCD readouts.

2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be 57.2 degrees C. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 15 by 15 m. Addressable heat detector devices shall be labeled on the outside face of the device and as applicable its' corresponding remote indicator. Label to include device's fire zone and unique device no. and shall match the fire alarm panel and remote LCD readouts.

2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base

contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.5.2.1 NOT USED

2.5.2.2 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel. Addressable smoke detector devices shall be labeled on the outside face of the device and as applicable its' corresponding remote indicator. Label to include device's fire zone and unique device no. and shall match the fire alarm panel and remote LCD readouts.

2.5.2.3 NOT USED

2.5.2.4 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 2.5 and 20 m/s. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 1.83 m and those mounted below 1.83 m that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility. Provide 8" square access door with rubber gasket in duct approximately 6" upstream from smoke detector for testing and service. Addressable duct detector devices shall be labeled on the outside face of the device and as applicable it's corresponding remote indicator. Label to include device's fire zone and unique device no. and shall match the fire alarm panel and remote LCD readouts.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

2.6.1 NOT USED

2.6.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box recessed (surface in the Maintenance Bay) vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 100 dBA at 3.05 m for the mechanical rooms and 87 dBA at 3.05 m elsewhere. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.6.3 NOT USED

2.6.4 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be semi-flush mounted. Strobes must meet ADA requirements of synchronization and intensity of flash.

2.6.5 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.6.6 Exterior Weather-Proof Combination Visable Notification Appliance

Weatherproof fire alarm visable fixture for wall mounting. It is intended for 120 VAC operations using a bulb of not over 100 watts (bulb not furnished). The globe furnished is red. To be used with fire alarm systems when the proper relay devices (by electrical Contractor) are used to actuate this unit.

The lamp circuit power should be obtained from the same source as for the fire alarm control panel and controlled either separately or in groups of parallel lamps but not in series with alarm signals.

2.6.7 Exterior Weather-Proof Combination Audible Notification Appliance

Heavy-Duty industrial, tone-selectable, notification appliances, capable of producing volume-controlled, high decibel tones. Thirteen (13) distinctive tones can be programmed by setting miniature switches within the unit.

The horn is a diode-polarized appliance for use in applications requiring electrical supervision of notification appliance circuit installation wiring. It may also be used on unsupervised circuits.

This intended for 120 VAC operation.

Available tones within each unit:

Siren	Yellow	Stutter	Chime
Rapid Siren	Horn	Hi-Lo	Ding-Dong
Slow Whoop	Beep	Warble	Vibrato
Fast Whoop			

TONE SELECTION CHART:

TONE	DESCRIPTION	dBA RATING @ 10 FT.
Siren	Conventional Siren Wail Tone	110dBA
Rapid Siren	Rapid Siren Tone	110dBA
Slow Whoop	Repeating Low to High Tone (4 seconds)	110dBA
Fast Whoop	Repeating Low to High Tone (1 seconds)	110dBA
Yeow	Repeating High to Low Tone (1.6 seconds)	110dBA
Horn	Steady Tone	103dBA
Beep	Slow Intermittent Horn Tone	103dBA
Stutter	Rapid Intermittent Horn Tone	103dBA
Hi-Lo	Alternating High and Low Tones	106dBA
Warble	Rapid Repeating High-Low Tone	106dBA
Chime	Repeating Ring Tone	106dBA
Ding-Dong	Alternating High-Low Ring Tones	106dBA

Vibrato Rapid Ring Tone 106dBA

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Electromagnetic Door Hold-Open Devices

Devices shall be attached to the walls unless otherwise indicated. Devices shall comply with the appropriate requirements of UL 228. Devices shall operate on 24 Volt dc power. Compatible magnetic component shall be attached to the door. Under normal conditions, the magnets shall attract and hold the doors open. when magnets are de-energized, they shall release the doors. Magnets shall have a holding force of 111.2 N. Devices shall be UL or FM approved. Housing for devices shall be brushed aluminum or stainless steel. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure.

2.7.2 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.7.3 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. J-boxes shall be a minimum of 4-11/16" square and 2 1/8" deep or larger as needed to accommodate the use of terminal blocks. all conduit J-box covers must be painted red and have the words "Fire Alarm" identified on the exterior surface. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited.

2.7.4 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

2.8 TRANSMITTERS

2.8.1 Radio Alarm Transmitters

Transmitters shall be capable of transmitting and communicating with the proprietary supervisory station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of NFPA 72, NFPA 1221, and 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly.

2.8.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

a. Operation: Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms for 15 minutes at the end of the 72-hour standby period.

2.8.1.2 Radio Alarm Transmitter Housing

Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to the fire alarm system for the building or identical to radio alarm transmitter housings on the base (coordinated with local jurisdiction). Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

2.8.1.3 Antenna

The Contractor shall provide antennae for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 161 km/h. Antennas shall not be mounted to any portion of the building roofing system.

2.9 LAPTOP COMPUTER

A laptop computer shall be furnished with the system which is capable of running the software and making any changes to the system that are required.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the

manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 300 mm nor more than 2000 mm above the finished floor. Manually operable controls shall be between 900 and 1100 mm above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 300 mm from any part of any lighting fixture. Detectors shall be located at least 900 mm from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

3.1.5 Notification Appliances

Notification appliances shall be mounted 2003 mm above the finished floor or 150 mm below the ceiling, whichever is lower.

3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.1.7 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

3.1.8 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall he mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated

for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.2.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 NOT USED

3.5 TESTING

The Contractor shall notify the Contracting Officer at least 30 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved fire alarm test plan in the presence of the Contractor's approved QC representative of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.5.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion and all preliminary test results data sheets with actual data values measured, and any schedule changes to previous fire alarm testing submitted dates for final acceptance.

3.5.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has

completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72, all specified performance criteria, approved fire alarm test plan and not limited to; but including the following:

a. Test each function of the main Fire Alarm Control Panel, Remote Graphics Annunciator Panel.

b. Visual inspections of wiring connections, operation of smoke dampers, air handler shut down, operation of magnetic door holders, operation of strobes, etc.

c. Measure loop resistance of circuits.

d. Measure for stray voltage on circuits.

e. Tests of ground fault on circuits.

f. Test each SLC per requirements NFPA 72 Table 3-6 Performance of Signal Line Circuits Style 6 Abnormal Conditions A through G, for trouble and alarm receipt capability during abnormal conditions.

g. Test each IDC per requirements NFPA 72 Table 3-5 Performance of Initiating Device Circuits Style D Abnormal Conditions A through D, for alarm, trouble, and alarm receipt capability during abnormal conditions.

h. Test each NAC per requirements NFPA 72 Table 3-7.1 Notification Appliance Circuits (NAC) Styles Z (as indicated per spec) Abnormal Conditions; Single Open, Single ground, and Wire-to-Wire short; for trouble and alarm receipt capability during abnormal conditions.

i. Tests for each alarm notification device. Check all strobes for synchronization. Measure and record bdA sound labels at 10 feet for audio annunciation devices, the general alarm dbA far room sound level measurements, and room ambient dbA sound level measurements, etc.

j. Tests for each control module, monitor module, etc.

k. Tests for each alarm-initiating device.

l. Transmission of alarm and trouble to the central fire station.

m. Tests of battery chargers and batteries.

n. Complete operational tests of complete fire alarm system under emergency power.

3.6 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

-- End of Section --

SECTION 13930A

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 135	(2001) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999el) Ductile Iron Castings
ASTM A 795	(2000) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(1999) Double Check Backflow Prevention Assembly

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1992; Addenda B301a - 1999) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(2000) Rubber-Gasket Joints for

	Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1997; Addenda C203a - 1999) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA EWW	(1999) Standard Methods for the Examination of Water and Wastewater
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1999) Installation of Sprinkler Systems
NFPA 230	(1999) Fire Protection of Storage
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1999) Building Materials Directory
UL Fire Prot Dir	(1999) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in all areas of the building areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge the minimum densities as indicated on the drawings over the hydraulically most demanding 140 square meters of floor area. The minimum pipe size for branch lines in gridded systems shall be 32 mm. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 6 m/s.

1.2.1.1 Hose Demand

An allowance for exterior hose streams as indicated on the drawings shall be added to the sprinkler system demand at the point of connection to the water system.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply characteristics shown on drawing. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed limits specified in NFPA 13 for hazard occupancy.

1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES::

SD-02 Shop Drawings

Sprinkler System Shop Drawings; G, AE.

Three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation. The Sprinkler System Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1:100 which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test

connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Shop Drawings; G, AE.

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

SD-03 Product Data

Fire Protection Related Submittals; G, AE.

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Load Calculations for Sizing Sway Bracing; G, AE.

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Components and Equipment Data; G, AE.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; G, AE.

Hydraulic calculations, including a drawing showing hydraulic

reference points and pipe segments.

Spare Parts

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

Preliminary Tests Procedures; G, RE

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests.

Final Acceptance Test Procedures; G, RE

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests.

On-site Training Schedule; G, RE

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Preliminary Tests; G, AE.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

Final Acceptance Test; G, AE.

Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Fire Protection Specialist Qualifications

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer Qualifications

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

SD-06 Test Reports

Preliminary Tests Report; G, AE.

Three copies of the completed Preliminary Tests Reports, no later that 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test Report; G, AE.

Three copies of the completed Final Acceptance Tests Reports, no later that 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

SD-07 Certificates

Fire Protection Specialist Inspection

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

SD-10 Operation and Maintenance Data

Wet Pipe Sprinkler System; G, AE.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply

curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.9 SPRINKLER SYSTEM INSTALLER QUALIFICATIONS

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe

Piping from a point 150 mm above the floor to a point 1500 mm outside the building wall shall be ductile iron with a rated working pressure of 1207 kPa conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 1500 mm outside the building walls shall comply with Section 02510A WATER DISTRIBUTION SYSTEM.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 900 mm above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel.

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53/A 53M,

or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Galvanized fittings shall be used for piping systems or portions of piping systems utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa service and shall be the product of the same manufacturer;segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm thick, and full face or self-centering flat ring type.

2.5.2 NOT USED

2.5.3 NOT USED

2.5.4 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized to be supported.

2.5.5 Valves

2.5.5.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

2.5.5.2 Check Valve

Check valve 50 mm and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 100 mm and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.6 Expansion/Surge Rank

Tank shell shall be carbon steel, constructed, tested and stamped in accordance with ASME BPV VII Div 1 for a working pressure 1206 kPa and shall be UL listed. Tank nominal volume shall be 9.5 liters with a 25 mm threaded inlet/outlet connection. Tank shall have a replaceable rubber bladder molded from synthetic nitrile rubber and charging valve. The bladder shall be precharged with dry nitrogen gas to 85% of the sprinkler system static pressure or as recommended by the manufacturer for this system. Tank shall be furnished with steel wall mounting bracket.

2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel (FACP) in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Elevator Power Shutdown Flow Switch, Vane Type

Switch shall be a vane type with a 25 mm (1 inch) NPT bushing and cast aluminum housing for use on wet sprinkler systems. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the sprinkler branch line pipe. The device shall sense water flow and be capable of detecting a sustained flow of 38 L/min (10 gpm) or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms. The switch shall be tamper resistant with cover tamper switch and two sets of SPDT (Form C) contacts, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dust proof cover and gasket to seal the mechanism from dirt and moisture.

2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 15 mm NPT male pipe thread. The switch shall have a maximum service pressure rating of 1207 kPa. There shall be two SPDT (Form C) contacts factory adjusted to operate at 28 to 55 kPa. The switch shall be capable of being mounted in any position in the alarm

line trim piping of the alarm check valve.

2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be projecting type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 65 mm diameter American National Fire Hose Connection Screw Threads (NH) per authority having jurisdiction.

2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be as indicated by NFPA 13. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13.

2.10.1 NOT USED

2.10.2 Recessed Sprinkler

Recessed sprinkler shall be chrome-plated and shall have a nominal 12.7 mm or 13.5 mm orifice.

2.10.3 NOT USED

2.10.4 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed type with nominal 12.7 mm or 13.5 mm orifice. Pendent sprinklers shall have a polished chrome finish.

2.10.5 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 12.7 mm or 13.5 mm orifice.

2.10.6 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 12.7 mm orifice. Sidewall sprinkler shall have a polished chrome finish. Sidewall sprinkler shall be the quick-response type.

2.10.7 NOT USED

2.10.8 NOT USED

2.10.9 Corrosion Resistant Sprinkler

Corrosion resistant sprinkler shall be the upright type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 20 mm and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.12.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located as indicated.

2.12.5 Identification Sign

Valve identification sign shall be minimum 150 mm wide x 50 mm high with enamel baked finish on minimum 1.214 mm steel or 0.6 mm aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.13 NOT USED

2.14 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 1207 kPa The maximum pressure loss shall be 40 kPa at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

PART 3 EXECUTION

3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 230.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 25 mm pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 300 mm . Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 25 mm below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 100 mm . Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.4.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 150 mm from ceiling grid.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 750 mm in length shall be individually supported.

3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. For pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer.

The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 15 mm (.

3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840A FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 25 mm pipe located in accordance with NFPA; a test valve located approximately 2 meters above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.4.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 11 liters, the auxiliary drain shall consist of a valve not smaller than 15 mm and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 11 liters, the auxiliary drain shall consist of two 25 mm valves and one 50 x 300 mm condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 25 mm in diameter. Tie-in drain lines shall be pitched a minimum of 15 mm per 3 mm.

3.4.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 900 mm above finished grade adjacent to and on the sprinkler system side of the backflow preventer. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 900 mm. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 1500 mm outside the building walls shall meet the requirements of Section 02510A WATER DISTRIBUTION SYSTEM.

3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02316A EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.7 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. Wiring color code shall remain uniform throughout the system.

3.8 DISINFECTION

After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system if filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After successful completion, verify installation of all sprinklers and plugs and pressure test the system.

3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.10.1 Underground Piping

3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 1.89 liters per hour per 100 gaskets or joints, regardless of pipe diameter.

3.10.2 Aboveground Piping

3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa or 350 kPa in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.10.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including65 mm diameter hoses, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. A metal placard shall be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be

made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.11 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

3.12 ON-SITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the Preliminary Tests and Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

SECTION 13965A

WET CHEMICAL FIRE EXTINGUISHING SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 17A	(1998) Wet Chemical Extinguishing Systems
NFPA 96	(1998) Ventilation Control and Fire Protection of Commercial Cooking Equipment

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	(1999) Fire Protection Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wet Chemical Fire Extinguishing System; G, AE

Drawings consisting of system layout including assembly and installation details and electrical connection diagrams; piping layout showing pipe sizes, lengths, and supports. Drawings shall include any information required to demonstrate that the system has been coordinated and will function as intended and shall show system relationship to items it protects and clearances required for operation and maintenance. Drawings shall also include conduit, cables, manual actuation stations and fusible links.

SD-03 Product Data

Similar Services; G, AE

Statement demonstrating successful completion of similar services on at least five projects of similar size and scope, at least 2 weeks before submittal of other items required by this section.

Wet Chemical Fire Extinguishing System; G, AE

Manufacturer's catalog data including detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration and shall be adequate to demonstrate compliance with contract requirements.

a. Storage containers and mounting brackets

b. Fusible links, cables, conduit, corner pulleys, and link mounting frames/brackets

c. Release mechanisms

d. Valves

e. Discharge nozzles

f. Piping components

g. Remote manual actuation stations

h. Fuel and power shutoff

i. Alarms, alarm devices, alarm interface(s), control panels

Preliminary Tests; G, AE

Proposed test procedures for preliminary test, at least 2 weeks before the start of related testing.

Final Acceptance Tests; G, AE

Proposed test procedures for final acceptance test, at least 2 weeks before the start of related testing.

System Diagrams; G, RE

Proposed diagrams, at least 2 weeks before the start of preliminary tests. System diagrams that show system layout and typed condensed normal and emergency operating procedures, methods for checking the system for normal, safe operation, and procedures for manual actuation shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

Test Schedule; G, RE

Proposed test schedule for acceptance test, at least 2 weeks before the start of related testing.

Field Training; G, RE

Proposed schedule for field training, at least 2 weeks before the start of related training.

SD-06 Test Reports

Preliminary Tests; G, RE

Test report for the preliminary tests in booklet form, upon completion of testing. Report shall document test results including repairs and adjustments made, and final test results.

Final Acceptance Tests; G, RE

Test report for the final acceptance tests in booklet form, upon completion of testing. Report shall document test results including repairs and adjustments made, and final test results. The weight of each storage container shall be recorded before final acceptance test and after test has been completed and containers recharged.

SD-07 Certificates

Installation Technician; G, RE

Concurrent with statement of similar services, manufacturer's certification of installation technician.

Installation Drawings; G, RE

Concurrent with installation drawings, manufacturer's certification of installation drawings.

SD-10 Operation and Maintenance Data

Wet Chemical Fire Extinguishing System; G, RE

Six manuals listing step-by-step procedures required for system actuation (automatic and manual), recharging, and routine maintenance, at least 2 weeks before field training. The manuals shall include the manufacturer's name, model number, parts list, list of tools and parts that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number). Service organization shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

1.3 GENERAL REQUIREMENTS

1.3.1 System Description

Each of the following cooking equipment items, including the exhaust hood, and exhaust duct serving the item shall be protected by preengineered wet chemical fire extinguishing system. System shall be installed with all accessories necessary for system to operate in accordance with manufacturer's instructions and as specified herein.

1.3.2 Regulatory Requirements

System application, design, and installation shall comply with NFPA 17A and NFPA 96, except as follows:

a. Compliance shall include conformance to the advisory provisions by changing "should" to "shall."

b. System components shall be listed in UL Fire Prot Dir or approved by FM P7825a and FM P7825b for use with wet chemical fire extinguishing systems.

c. Reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

d. The use of grease extractors does not eliminate the requirement that duct systems, grease removal devices, and hoods be protected by the wet chemical extinguishing system.

1.3.3 Installation Drawings

Installation drawings shall be prepared by a representative of the manufacturer to ensure compliance with the requirements listed herein and with all manufacturer's requirements and recommendations.

1.3.4 Installation Technician

The installation technician shall have been trained by the system manufacturer for system installation, operation, and maintenance.

1.4 COORDINATION OF TRADES

Each system shall be coordinated with the equipment, hood, and exhaust ducts that it protects along with other construction in order to eliminate any interference.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

System components shall be the standard products of a manufacturer regularly engaged in the manufacturing of products that are of similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include installations of systems under similar circumstances and of similar size. Systems shall be supported by a service organization.

2.2 PIPING COMPONENTS

2.2.1 Pipe and Fittings

Pipe and fittings shall be Schedule 40 stainless steel. Stainless steel tubing may be used in accordance with manufacturer's recommendations. Galvanized pipe shall not be used.

2.2.2 Nozzles

Nozzles shall be stainless steel and shall be equipped with an integral strainer to prevent matter inside the distribution piping from clogging the nozzle orifice. Each nozzle orifice shall be provided with a seal to protect the nozzle from clogging by grease or other obstructions. This seal shall detach upon actuation.

2.3 SYSTEM CONTROLS

Each system shall be actuated by fusible link and by a remote manual actuation station connected to the extinguishing system release mechanism by cable. Remote manual actuation stations shall be located along the path of egress and shall automatically actuate the building fire alarm system. The system controls shall automatically shut off fuel flow and electrical power to the protected appliances and other appliances located under the ventilating system protected by the extinguishing system upon system actuation. All cables used shall be stainless steel with corner pulleys employing stainless steel ball bearings at all corners. All cable and wiring shall be enclosed in conduit.

2.4 NOT USED

2.5 WET CHEMICAL

The wet chemical shall not have an adverse effect on stainless steel during exposure periods of up to 24 hours.

2.6 IDENTIFICATION SIGNS

Identification signs shall be located at each remote manual actuation station. Signs shall be fabricated of rigid plastic, red in color, with engraved white letters that are a minimum 6.5 mm inches in height. Each sign shall be engraved with "Fire Extinguishing System" and with a brief description of the equipment protected.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be performed by the installation technician in accordance with system manufacturer's instructions. Ductwork access doors shall be provided where indicated and at any items requiring service and inspection, including nozzles and fusible links. Ductwork access doors shall be in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.2 PRELIMINARY TESTS

After installation has been completed, each system shall be actuated by both fusible link and by remote actuation station to demonstrate proper function of all components, including alarms and fuel flow and power shut off. Actuation by fusible link shall be in a manner approved by the system manufacturer. Test containers, pressurized with either nitrogen or air to normal system operating pressure and of the same size as actual operating containers shall be discharged into system. The seals shall release as during normal actuation. After each discharge, the nozzles shall be removed, disassembled, and strainers shall be cleaned. System piping shall be inspected and cleaned as necessary. All functions of system operation shall be verified, including switches, shutdown of fuel and power to appliances protected by the system or served by the same ventilation system, uniform delivery of air or nitrogen, and activation of alarms. Nozzle seals/covers shall be replaced after the preliminary tests are complete. In the event portions of the tests are unsuccessful, repairs shall be made and the entire test repeated until successful.

3.3 FINAL ACCEPTANCE TESTS

System shall be actuated by both fusible link and remote manual actuation station and all system functions shall be verified as described in Paragraph PRELIMINARY TESTS using test containers specified for preliminary tests, or if required by the authority having jurisdiction using actual system containers fully charged with wet chemical shall be used. Each nozzle shall be provided with a plastic container, hose, and hose fitting to capture all wet chemical discharged. All tests or checks recommended by the manufacturer shall also be performed. In the event portions of the tests are unsuccessful, repairs shall be made and the entire test repeated until successful. Nozzle seals/covers shall be replaced after the final acceptance tests are complete. The system shall be returned to normal operating condition after the completion of testing and wet chemical containers expended shall be recharged and verified leak tight. Extinguishing system and equipment and duct protected by the extinguishing shall be cleaned after completion of testing. Any damage shall be repaired by the Contractor. The weight of each storage container shall be recorded before final acceptance test and after test has been completed and containers recharged.

3.4 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 2 hours of normal working time and shall start after the system is functionally complete but prior to the final acceptance test. The field instruction shall cover all of the items contained in the approved Operation and Maintenance Instructions.

-- End of Section --

SECTION 14240A

ELEVATORS, HYDRAULIC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 176	(1999) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 366/A 366M	(1997el) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 568/A 568M	(1998el) Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
ASTM A 569/A 569M	(1998) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled
ASTM D 92	(1998a) Flash and Fire Points by Cleveland Open Cup (IP36/84(89)
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

ASME INTERNATIONAL (ASME)

ASME A17.1	(1998a) Safety Code for Elevators and Escalators
ASME A17.2.2	(1998) Inspectors' Manual for Hydraulic Elevators
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded

ASME B31.1	(1998) Power Piping
ASME QEI-1	(1997) Standard for the Qualification of Elevator Inspectors

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD 795	(Basic) Uniform Federal Accessibility Standards

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO Building Code	(1997) Uniform Building Code (3 Vol.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates
NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 252	(1999) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Elevator System; G, RE

Detail drawings including dimensioned layouts in plan and elevation showing the arrangement of elevator equipment, anchorage of equipment, clearances for maintenance and operation; and details on hoistway, doors and frames, operation and signal stations, controllers, motors, guide rails and brackets, cylinder and plunge unit, and points of interface with normal power fire

alarm system, HVAC or exhaust systems, and interface with emergency power systems. Drawings shall show any revised building electrical system required to make supplied elevator system function as specified. Drawings shall contain complete wiring diagrams showing electrical connections and other details required to demonstrate sequence of operation and functions of system devices. Drawings shall include the appropriate sizing of electrical protective devices which are frequently different from National Electrical Code standard sizes.

SD-03 Product Data

Training Data

Information describing the training course for operating personnel, training aids and samples of materials to be used, training schedules, and notification of training.

Elevator System; G, RE

A complete list of equipment and material, including illustrations, schedules, manufacturer's descriptive data and technical literature, performance charts, catalog cuts, installation instructions, brochures, diagrams, and other information required for fabrication and installation of the equipment. Data shall include calculations for reaction loads imposed on building by elevator systems and to demonstrate that the proposed elevator system conforms to paragraph SEISMIC REQUIREMENTS. Certified copies of list reports may be submitted in lieu of calculations. Calculations to demonstrate compliance with ASME A17.1, Rule XXIV shall be included. Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than 4 weeks prior to date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended to be replaced and replacement interval required. Data shall include appropriate sizing of electrical protective devices.

Framed Instructions

Diagrams, instructions, and other sheets proposed for posting.

Test Procedures; G, RE

A plan detailing the testing procedures shall be submitted 60 days prior to performing the elevator tests.

SD-04 Samples

Finishes; G, RE

Samples of materials and products requiring color or finish selection.

SD-06 Test Reports

Testing

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of installed system.

SD-07 Certificates

Qualification Certificates

Certificates of experience of elevator mechanics employed to install, supervise and test the elevator shall certify mechanics to have not less than 5 years experience installing, supervising and testing elevators of the type and rating specified. Certificate shall certify that elevator system installer is acceptable to elevator manufacturer prior to installation of elevators.

SD-10 Operation and Maintenance Data

Elevator System; G, RE

Six copies of operation manual outlining the step-by-step procedures for system startup, operation and shutdown. Manuals shall include manufacturer's name, model number, service manual, parts list and brief description of all equipment, including basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Manuals shall include equipment layout and complete wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to training course.

1.3 QUALIFICATIONS

Hydraulic elevators shall be pre-engineered elevator systems, and provided by a company regularly engaged in the manufacture of elevator systems. The manufacturer shall either install the elevator system or provide letter of endorsement certifying that the elevator-system installer is acceptable to the manufacturer.

1.4 REGULATORY REQUIREMENTS

Design and fabrication shall be in accordance with ASME A17.1. Each car shall have the capacity to lift a live load, exclusive of the car, at a speed as specified in the following schedule. The approximate travel, terminal floors, number of stops and openings, and the car sizes shall be as shown in the schedule. The elevators shall serve the floors with stops and openings in accordance with the requirements indicated. Elevators shall provide accessibility and usability for physically handicapped in

accordance with the requirements for the handicapped in FED-STD 795 and 36 CFR 1191.

1.4.1 Elevator Schedule (Passenger)

Number of Elevators Required:	1
Service:	Passenger
Capacity:	134 kg (2500 pounds)
Speed:	0.75 m/s (150 fpm)
Platform Size:	2133 wide by 1550 deep
Clear Car Inside:	2032 wide by 1795 deep
Net Travel:	4 M
Landings:	2
Openings: Front	2
Openings: Rear	None
Entrance Type:	Center-opening Horizontal-sliding

1.5 DESIGNATED LANDING

For the purposes of firefighter's service and emergency operations, as required by Section 211, ASME A17.1, the designated landing or level shall be the first floor.

1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variations; and dirt, or other contaminants.

1.7 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing any work.

1.8 WARRANTY

Warranty service shall be provided for each elevator for a period of 12 months after date of acceptance by Contracting Officer. Warranty service shall be performed only by trained elevator mechanics during regular working hours and shall include manufacturer's warranty requirements including but not limited to adjusting, lubricating and cleaning of equipment and furnishing supplies and parts to keep elevator in operation,

except such parts made necessary by misuse, accident or negligence not caused by the Contractor. Testing and adjustments shall be in accordance with the applicable provisions of ASME A17.1 and ASME A17.2.2. Emergency callback service shall be included and available 24 hours a day, 7 days per week, with an initial telephone response time of 1 hour and a response time of 4 hours for a mechanic to the site. Inspection and service for fire service operation seismic requirements shall be performed every 6 months. Documentation of inspection and testing, and certification of successful operation shall be provided with each unit.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Material and equipment shall be the standard products of manufacturers regularly engaged in the fabrication of elevators and/or elevator parts, and shall essentially duplicate items which have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is available 24 hours a day, 7 days per week, with a response time of 4 hours.

2.1.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, and electrical and mechanical characteristics on a plate secured to the item of equipment.

2.1.3 Special Tools

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

2.1.4 Electrical Work

Changes to the electrical distribution system required for coordination with elevator equipment shall be performed and coordinated by Contractor, at Contractor's expense. Electrical service for elevator machines shall be 460 volt, 60-Hertz, 3-phase, 4 wire solid neutral grounded alternating current. Electric service for elevator car lighting shall be 120-volt, single-phase, 60-Hertz grounded service. Electrical work shall conform to requirements in Section 16415 ELECTRICAL WORK, INTERIOR. A single-phase electric circuit with grounded connection for video monitor shall be provided in machine room.

2.1.5 Use of Asbestos Products

Materials and products required for manufacturing and installing elevators shall not contain asbestos.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Materials for Car Enclosures

Materials for car enclosures shall meet flame spread rating 0 to 75 and smoke development 0 to 450 as tested in accordance with requirements of ASTM E 84 as established by ASME A17.1, Rule 204.2.

2.2.2 Structural Steel

Structural steel shall be hot-rolled commercial quality carbon steel, pickled, oiled, complying with ASTM A 569/A 569M and ASTM A 568/A 568M.

2.2.3 Cold-Rolled Sheet Steel

Sheet steel shall be cold-rolled commercial quality low carbon steel, Class 1, exposed matte finish, oiled, complying with ASTM A 366/A 366M and ASTM A 568/A 568M.

2.2.4 Stainless Steel

Stainless steel shall be ASTM A 176 Type 302/304, austenitic, corrosion-resistant, with grain of belting in the direction of longest dimension. Surfaces shall be smooth and without waves and shall be in compliance with ASTM A 366/A 366M.

2.3 PASSENGER ELEVATOR CAR

2.3.1 Car Fronts

Fronts for passenger elevators shall be combination door post and return panels manufactured of 1.9837 mm thick (14 gauge) stainless steel provided with necessary cutouts for operating devices. Car operating panel shall be recessed into front return panel with surface-applied operating panel cover. Position indicator in front return shall be recessed with a surface-applied cover plate. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified.

2.3.2 Car Doors

Car doors for passenger elevators shall be constructed from 1.519 mm thick (16 gauge) sheet steel and stainless steel cladding. Each door shall be sound-deadened and reinforced to receive required operating mechanism and hardware, and have two removable door guides per panel. Seams, screws or binding strips shall not be visible from within the car. Threshold shall be extruded aluminum with grooves for door guides. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified. Car doors shall be equipped with a proximity-type infrared protective device having the following operation:

a. When doors are in full-open position, doors shall be unable to initiate closing if a person comes within detection zone. Detection zone moves with doors, so that if a passenger or object enters the zone after doors have begun to close, doors shall stop, then reverse to reopen. Doors shall reclose after a brief time. A passenger entering or leaving cars shall not cause doors to reopen unless doors reach a predetermined proximity to passenger.

b. After a stop is made, doors shall remain open for a time to permit passenger transfer, after which doors shall close automatically. This time interval shall be less for a car call than for a hall call or a coincident car/hall call.

c. If there is either a hall call anywhere in the group or a car call in the car in question and doors are prevented from closing for a fixed time period, door protective device shall be rendered inoperative, a buzzer shall sound in car and doors shall close at approximately half speed. Normal door operation shall resume at next landing reached by car.

2.3.3 Car Platform

Car platform for passenger elevators shall be fabricated from steel plates secured to a steel frame or plywood secured to a steel frame. Steel car platforms shall be assembled into a one-piece platform with top and bottom steel plates welded to structural steel frame and covered with felt and sound-isolation. Plywood car platform shall be 18 mm (3/4 inch) thick Exposure 1 plywood secured to underside of structural steel frame with metal fire protection secured to underside of structural steel frame.

2.3.4 Sling

Sling for passenger elevators shall be constructed of heavy steel stiles properly affixed to a steel crosshead and bolster with adequate bracing members to remove all strain from car enclosure. Steel bumpers shall be furnished for fastening sling to plunger.

2.3.5 Walls

Walls for passenger elevators shall be 2426 mm (7 feet 11-1/2 inches) high from floor to the underside of lighting fixtures. Side and rear panels shall be 1.519 mm thick (16 gauge) sheet steel panels. Side and rear removable panels shall be applied to car walls and shall be manufactured from 18 mm (3/4 inch) plywood or composition board finished on front, back and edges faced with plastic laminate conforming to NEMA LD 3, general purpose type. Panels shall be mounted on car walls in a manner permitting their reversing. Panels shall be evenly spaced with not less than two panels on each side and three panels at rear with 9.5 mm (3/8 inch) separations backed up with stainless steel dividers. Vent around base shall be concealed behind removable panels.

2.3.6 Car Top, Ceiling and Light Fixtures

Car top for passenger elevators shall be manufactured from 2.657 mm thick (12 gauge) sheet steel and shall be not less than 140 mm high with drop-ceiling and light fixtures. Ceiling shall be 3 mm (1/8 inch) thick translucent white plastic fire-retardant light diffuser supported by baked-enamel perimeter frame and dividers to form drop-ceiling light fixture. Light fixtures shall be fluorescent type flush with car ceiling, manufactured of sheet steel with flange and enclosed sides and top, baked-enamel reflector, mounted directly to outlet box. Bottom of fixtures

shall be flush with car ceiling. Fluorescent light fixtures shall be dual lamp with quick-starting high-power factor, Class P ballasts with safety lamp guard clamps on fluorescent tubes. Light level shall average at least 108 lx (10 footcandles) measured at the car threshold, with the door closed. A part of car light fixture shall be removable to permit use of the emergency exit panel in top of car.

2.3.7 Emergency Exit

Car top for passenger elevators shall be manufactured with a hinged emergency exit panel of 2.657 mm thick (12 gauge) steel which opens up to clear the crosshead and car door operator. Emergency exit panel shall be hinged on counterweight side and held in place with nonremovable fastening devices at each corner, and be openable from top of car only. A minimum of two sides of exit panel shall lap exit opening by 25 mm. Exits shall be equipped with electrical contacts which will prevent operation of car when the exit door is open and cause the alarm bell to ring.

2.3.8 Floor Finish

Floor finish for passenger elevators shall be finished with quartz floortile as specified in Section 09915 COLOR SCHEDULE. Tile shall be laid flush with the extruded aluminum platform threshold.

2.3.9 Base

Base for passenger elevators shall be cove type stainless steel, 150 mm (6 inches) high.

2.3.10 Handrails

Handrails for passenger elevators shall be mounted on each wall and shall comply with ASME A17.1, FED-STD 795 and 36 CFR 1191. For elevators with two-speed horizontal-slide openings, handrails shall be turned back to wall.

2.3.11 Exhaust Fan

Exhaust fan for passenger elevators shall be two-speed exhaust type ventilating unit mounted in car ceiling and shall be provided with a stainless steel grille. Units shall be suitably isolated from car ceiling and shall provide at top speed of a minimum of 6 air changes per hour for car volume and car occupancy. Switches for the operation of the exhaust unit shall be located in car station locked cabinet or key-switched.

2.3.12 Communications

A telephone system in stainless steel cabinets shall be provided for passenger elevators. A vandal-resistant speaker type intercom with push-buttons to activate shall be installed in car station behind a stainless steel perforated grille and connected to a programmable auto-dialer located in machine room. Auto-dialer shall be provided with a solid-state charger unit which will automatically provide emergency power and an immediate transfer in the event of failure of normal power supply. The push-button located in car station or in separate cabinet shall be at

the prescribed handicapped height and shall be identified as "EMERGENCY PHONE PUSH TO ACTIVATE". The entire communication assembly shall be approved for an elevator installation. The push button telephone shall comply with FED-STD 795 and 36 CFR 1191. The telephone communication shall not be terminated until one of the communicating parties hangs up the receiver or manually disconnects the communication link.

2.3.13 Car Emergency Lighting System

Emergency car lighting system for passenger elevators shall consist of an emergency power pack on top of the elevator and a remote lighting fixture inside elevator car located in car operating panel.

2.3.13.1 Power Pack

Power pack for emergency lighting system shall be a sealed lead-cadmium or nickel-cadmium 6-volt rechargeable batteries with solid-state controls and an integral regulating charger connected to normal power supply. Power pack unit shall contain the following:

a. Minimum 150 mm (6 inch) diameter alarm bell connected to the elevator alarm and emergency push-button.

b. Top of car light fixture with protective wire guard.

c. Testing circuit and pilot light.

d. Low-wattage pilot light indicator.

e. Battery low-voltage disconnect.

2.3.13.2 Emergency Light Fixture

Emergency light fixture shall be located in car station inside elevator car, with flush-mounted lens and shall consist of the following:

a. A minimum of two lamps capable of providing a minimum level of illumination of 10.8 lx (1.0 footcandle) at a point 1220 mm (4 feet) above the floor, 300 mm (1 foot) in front of car station.

b. Steel fixture frame with chrome finish.

c. Frosted acrylic lens, 6 mm (1/4 inch).

2.3.13.3 Remote Light Fixture

Upon interruption of normal power, remote light fixture for passenger elevators shall automatically and immediately illuminate and permit operation of alarm bell, subject to activation of emergency stop-switch or alarm button. Emergency power pack shall be capable of providing a minimum of 1 hour emergency bell operation and 4 hours of continuous illumination.

2.3.14 Protection Pads

Passenger Elevator Car No. One: Car shall be provided with wall protection pads with inconspicuous stainless steel pad hooks spaced not over 460 mm apart near the ceiling. Pads shall be heavy-quality fire-retardant treated canvas with two layers of sewn cotton batting with metal eyelets for each pad hook. Pads shall cover entire wall surface except operating devices. Pads shall be flame retardant in accordance with ASME A17.1, Rule 204.2.

2.3.15 Certificate Frame

A stainless steel certificate frame with translucent plexiglass lens of the appropriate size to receive certificate issued by inspecting agency shall be provided. Frame shall be engraved to show name of manufacturer, carrying capacity in kilograms (pounds) and maximum number of persons allowed.

2.3.16 Car Guide Shoes

Guide shoes for passenger elevators shall be the adjustable mounting type on each side of car. Shoes shall be rigidly secured in accurate alignment at top and bottom of car frame. Flexible type sliding guide shoes shall consist of a swivel-type shoe, assembled on a metal base with provisions for self-alignment. Each shoe shall be provided with renewable gibs. Car guide shoes shall be adjustable for side play between guide rails. Renewable wearing gibs shall be fabricated from a durable plastic compound material having a low coefficient of friction and long wearing qualities. Gibs shall be the type requiring minimum rail lubrication.

2.4 PASSENGER ELEVATOR HOISTWAY ENTRANCES

2.4.1 Hoistway Doors

Hoistway doors for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Doors for passenger elevators shall be hollow metal type with plain panel design not less than 32 mm (1-1/4 inches) thick with 1.519 mm thick (16 gauge) face sheet-steel panels, and stainless steel cladding, with 1.519 mm thick (16 gauge) sight guards to match door finish. Each door shall be reinforced with continuous vertical members and filled with sound-deadening material. Doors shall be reinforced to accept the required operating mechanism and hardware. Doors shall have two removable door guides per panel. Seams, binding strips or screws shall not be visible from the landing. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified.

2.4.2 Hoistway Frames

Hoistway frames for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Frames shall be formed 1.897 mm thick (14 gauge) sheet-steel with stainless steel cladding with head and jamb in flush alignment and corners welded and ground smooth. Head and jamb section shall be bolted assembly with bolts, washer and locking nut or lock washer. Frame assembly

shall be securely fastened to the structure. Frames shall return to the wall. Combination buck and jamb frames may be provided with knockdown back flanges to permit installation in concrete walls. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified.

2.4.3 Symbols

Raised stainless steel symbols as required by FED-STD 795 and 36 CFR 1191 of color selected, shall be provided at each floor to indicate the floor location. Symbols shall be attached with concealed fasteners. Symbols shall be placed in a location which can be seen by passenger from the opened passenger elevator doors.

2.4.4 Sills

Sills for passenger elevators shall be extruded aluminum with slip-resistant surface and machined grooves for door guides, secured to floor beams.

2.4.5 Strut Angles

Strut angles for passenger elevators shall be structural steel of size not less than 76 x 76 x 5 mm (3 x 3 x 3/16 inch) extending from sill to beam above and anchored to building structure with structural steel fastenings and bracings of structural members with a cross section of not less than strut angles.

2.4.6 Door Hangers and Housing

Each door panel shall be provided with not less than two sheave-type hangers designed for required door operation. Hanger housing and support shall be fabricated from formed Z-shaped steel angles of size not less than 5 mm (3/16 inch) thick bolted to strut angles.

2.4.7 Door Rollers

Door rollers shall be constructed with grease-packed ball-bearings and shall be tired with a sound-reducing material. Diameter of rollers shall not be less than 83 mm (3-1/4 inches) for car doors and not less than 57 mm (2-1/4 inches) for hoistway doors. Upward thrust shall be taken by a hardened and ground ball-bearing roller assembled on an eccentric stud to provide adjustment.

2.4.8 Hanger Track

Hanger track shall be of high carbon cold-drawn steel, round at top to receive door rollers, round at bottom to receive up-thrust rollers, of size engineered to accommodate load requirements.

2.4.9 Covers and Guards

Hanger covers, dust covers, toe guards and fascia plate shall be fabricated from 1.519 mm thick (16 gauge) reinforced steel and finished with baked-enamel. Hanger covers shall extend the full door travel and shall be

mounted in sections for ease of servicing door hangers. Dust covers shall be provided over top terminal landing door only and shall be secured to hanger housing and building structure. Toe guards shall be secured to sill. Fascia plates shall be provided between each door hanger housing and sill.

2.5 PASSENGER ELEVATOR DOOR OPERATION

Car and hoistway doors for passenger elevators shall be operated simultaneously by an electric-power door operator. Doors shall operate smoothly in the opening direction and closing direction and be electrically or hydraulically cushioned to stop at both the full-open and full-closed position. Operators shall be high-speed heavy-duty type which will provide an average door-opening speed of 0.76 m/s (2-1/2 fps). Car and hoistway doors shall be opened and closed simultaneously in a maximum time of .76 m/s (2 1/2 fps). When on automatic operation door-closing time shall not exceed 2.4 seconds and door-closing force shall not exceed 130 N (30 pounds). Reversal of doors when closing shall be accomplished by the "DOOR OPEN" button, car door safety edge, or interruption of the photoelectric light beams. Doors shall be arranged so that doors can be opened manually in the event of power failure.

2.6 PASSENGER ELEVATOR OPERATING AND SIGNAL FIXTURES

2.6.1 General

Elevator fixtures and panels for passenger elevators shall be constructed of 3 mm (1/8 inch) thick faceplates of stainless steel. Fastenings for all exposed fixtures shall be secured with tamper-proof spanner-head screws of same material and finish as fixture. Hall and car call-buttons shall be the call-register type with a low-voltage power supply not to exceed 48 volts. Pressure on a button shall illuminate button to indicate that a call in the desired direction has been registered. Car and hall fixtures shall be designed and located at the prescribed height to accommodate the handicapped in accordance with FED-STD 795 and 36 CFR 1191 for passenger elevators only. Handicapped markings shall be integral with faceplates in accordance with FED-STD 795 and 36 CFR 1191. Surface-applied markings are not acceptable. Engraving shall be black-filled except for fire-service identification which shall be red-filled. Operating and signal fixture contacts and lamps shall be completely enclosed in steel boxes finished with a baked-enamel. Boxes for hall landing devices shall be equipped for proper adjustment to wall. Lamps shall be installed in light-tight compartments. Cover-plates shall be provided with rubber gaskets when exposed to weather or harmful contaminants. Replacement bulbs shall be readily available from three sources.

2.6.2 Car Operating Panel

Car operating panel for passenger elevators shall be provided with the necessary raised (0.8 mm (0.03 inch)) markings for the handicapped, and shall include a series of minimum 20 mm (3/4 inch) diameter or square push-buttons numbered to correspond to the floor served and various additional switches, buttons and light jewels, including emergency stop, alarm button, "DOOR OPEN" button and communication speaker. Operating

buttons shall be of manufacturer's standard design. Buttons and switches not required for automatic or fire-service operation shall be key-operated and mounted on front-return car operating station. Elevator number and "NO SMOKING" shall be international symbol engraved on upper portion of car. Operating panel in car shall consist of a flush-mounted panel containing the following operating devices:

a. "DOOR OPEN" button.

b. "DOOR CLOSE" button.

c. Key-operated car fan/light switch.

d. Key-operated ventilating blower switch/call light.

e. Communication speaker phone, grille and push-to-call button.

f. Emergency stop-switch key-operated when operated will stop the car independently of normal stopping devices. Operation of emergency stop switch shall not cause any power variance or surge that may affect the operation or condition of the control panel or its components.

g. Emergency signal-switch connected to a 150 mm (6 inch) diameter signal bell outside of elevator hoistway at first floor located as shown or as directed.

h. Key-operated independent operation switch (for multi-car only).

i. Key-operated inspection switch which will render normal operation inoperative for the purpose of using the hoistway access switch.

j. Key-operated fire-service switch and light jewel.

2.6.3 Auxiliary Car Operating Panel

Auxiliary car operating panel for passenger elevators shall be similar in design to main car panel, and shall include all devices necessary for automatic operation such as emergency stop switch, alarm bell, "DOOR OPEN" button.

2.6.4 Hall-Call Station

Hall-call operating devices for passenger elevators at landing shall consist of an "UP" push-button at bottom landing, a "DOWN" push-button at top landing, and "UP" and "DOWN" push-buttons at all other landings. Buttons shall be manufacturer's standard design. Buttons shall be designed with 0.8 mm (1/32 inch) operating clearance to seat on faceplate in lieu of button mechanism. Buttons shall have maximum protrusion of 5 mm (3/16 inch) beyond faceplate with beveled edges to prevent damage from side blows.

2.6.4.1 Commandeering Switch

Key-operated commandeering switch for passenger elevators shall be provided

at each landing and located in landing call-button cover plate. Switch shall be momentary pressure type with the key removable only in "Off" position and shall be keyed to match the independent operation switch specified for car operating devices.

2.6.4.2 Fire-Service Switch

Fire-service switch for passenger elevators shall be located at the designated landing.

2.6.5 Direction Lanterns

Lanterns for passenger elevators shall be in accordance with FED-STD 795 and 36 CFR 1191 and shall be provided at all floor landings and in each car entrance column. Lanterns shall be the manufacturer's standard design. Lanterns shall signal the approach of a stopping car when car is a predetermined distance from landing.

2.6.6 In-Car Car-Position Indicator

Indicator numerals and directional arrows for passenger elevators shall be 25 mm (1 inch) high, white translucent plastic. As car travels through hoistway the car position shall be indicated by illumination of light jewel corresponding to landing at which the car is stopped or passing. Necessary light baffles shall be provided. Floor numerals and letters shall illuminate white. A position indicator of the digital-readout or dot-matrix type (minimum 50 mm (2 inch) high indication) shall be provided in car transom panel. Number corresponding to car position shall remain illuminated when motor drive is shut down. Illumination shall be shrouded in an approved manner to protect against glare from car lighting.

2.6.7 Audible Signals

An automatic voice announcement of the floor landing at which the car stops shall be provided inside each car. In addition, an audible signal shall be provided at each floor landing and shall sound coincident with the landing lantern illumination indicator. The audible signal shall be no less than 20 decibels with a frequency no higher than 1500 Hz. The audible signal shall sound once for UP direction and twice for DOWN direction.

2.6.8 Combination Hall-Position Indicator and Directional Arrows

Combination hall-position indicator and directional arrows for passenger elevators shall be provided at first floor landing directly above entrance frame. As elevator travels in hoistway, elevator position shall be indicated by illumination in alpha-numeric characters corresponding to the landing where elevator is stopped or passing. Number corresponding to position of car shall remain illuminated when motor is shut down. An audible signal shall sound in elevator car to indicate that the elevator is stopping or passing a floor served by elevator. Fixture design and operation shall be similar in design to that specified for Car Position Indicator.

2.7 NOT USED

2.8 PASSENGER CAR OPERATION (SINGLE-CAR SELECTIVE/COLLECTIVE)

Passenger Elevator No. One: Car shall be arranged so that by pressing one or more car buttons or landing buttons the car will start automatically and stop at first floor for which the button has been pressed which corresponds to the direction in which the car is traveling. Car shall stop in the order in which the floors are reached by the car and at all floors for which calls have been registered, regardless of the sequence in which buttons have been pressed, provided button for a given floor has been pressed sufficiently in advance of car's arrival at that floor to permit the stop to be made. If car buttons have not been pressed, and car responds to several DOWN calls, car shall travel to highest DOWN call first and then reverse to collect UP calls. UP calls shall be collected in the same way when car starts DOWN in response to UP calls by first stopping for the lowest UP call registered. When a car has stopped in response to the pressing of a landing button and a car button is pressed corresponding to the direction in which the car has been traveling, within a predetermined interval of time after the stop, the car shall continue in that direction regardless of other landing calls registered. While car is in motion landing calls in the opposite direction of car movement shall not affect the operation of car but calls shall remain registered. After last car call has been answered in the direction the car is traveling, car shall automatically reverse and answer registered landing calls and all car calls in the order the landings are reached. When all calls have been answered, the car shall stop at the last floor served and shall have the doors closed.

2.9 NOT USED

2.10 NOT USED

2.11 NOT USED

2.12 NOT USED

2.13 NOT USED

2.14 NOT USED

2.15 AUTOMATIC EMERGENCY POWER OPERATION

Elevator control system shall be arranged to operate on emergency power supply upon failure of the normal power supply. Elevators operating on dedicated service, such as fire service, will not be required to return to designated landing when emergency power becomes available for respective elevator. Elevators shall operate as follows:

a. When normal power supply fails, all cars shall shut down.

b. One car shall automatically start and travel at full-rated speed to designated landing, stop, open the car and hoistway doors, then shut down.

2.16 AUTOMATIC ELEVATOR OPERATION

2.16.1 General

The operating device shall consist of a series of push-buttons in the car numbered to correspond to various landings, "UP" and "DOWN" buttons at intermediate landings and a single button at terminal landing. To meet the elevator operation requirements specified in this section all buttons shall be connected electrically to the control system which governs the floor selection, car selection, direction of travel and governs the acceleration and retardation.

2.16.2 Operation

Car calls shall be registered within the car by pressing the button corresponding to the designated floors. Hall calls shall be registered by pressing buttons in the corridor push-button fixture. Once the demand for elevator service has been established and the car has received a start signal the car operation shall be as follows.

2.16.2.1 Door Closing

Doors shall close automatically. When doors are fully closed and the interlock circuit established, the car shall start to move in the direction established by control system. Car shall accelerate and decelerate automatically and stop at floor for which a car button has been registered.

2.16.2.2 Door Opening

Doors shall open automatically as car reaches the landing. After a predetermined time the doors shall close and the car shall proceed to answer the remaining car or assigned corridor calls. A protective device such as a safety edge and light beam device shall be provided on car door and when activated will prevent closing of doors. Cars shall become available for assignment at whatever floor the last car demand has been satisfied in the direction in which the car is traveling.

2.16.2.3 Car Dispatch

When car does not receive a demand dispatch at dispatching floor for an adjustable time period up to 10 minutes set initially at 5 minutes, the motor drive unit shall be switched-off. If the car's switched-off motor drive unit receives a demand dispatch the motor drive unit shall automatically restart.

2.16.2.4 Door Dwell-Time

Door open dwell-times shall be adjustable so that the open time for a car call is shorter than the open time for corridor calls and second passengers. If a longer time is needed for passenger entry, doors can be prevented from closing or reversing by the light beam door control, the protective leading edge on car door, or by pressing "DOOR OPEN" button in car. Door dwell-times shall comply with FED-STD 795 and 36 CFR 1191.

2.16.3 NOT USED

2.16.4 Automatic Load Weighing

Passenger elevators shall be provided with load-weighing devices which will cause elevator to bypass hall calls when elevator is filled to an adjustable percentage. Corridor calls shall remain registered until the next available car responds to the call.

2.16.5 Anti-Nuisance

Passenger elevators shall be provided with a system which will cancel all car calls in the event that between 3 to 5 times the number of car calls are registered as there are passengers in car, allowing 70 kg per passenger.

2.16.6 Door Operation

Double-door operation are not acceptable for passenger elevators. If an UP traveling car has a passenger for an intermediate floor and a DOWN call is registered at that floor with no-calls above car, the car shall travel to floor, open the door and let passenger out, then light the DOWN direction arrow in hall lantern and accept the waiting passenger who registered the DOWN call. Doors shall not perform the open-close cycle before elevator proceeds to next call.

2.16.7 Automatic Power Shutdown

Automatic power shutdown of the elevators will be initiated by a waterflow switch supervising sprinklers located in the elevator machine room or in the elevator hoistway. Heat detectors shall be connected to the elevator control system which shall cause the following to the affected elevators), upon activation of the heat detector.

a. Elevators which are in motion will proceed to the nearest available landing away from fire floor, and shall cause power-operated doors to open and remain open until manually reset.. The fire floor is considered the floor where the actuated heat detector is located.

b. Elevators which are standing at a landing with open doors will remain open at the floor. If power-operated doors are closed, the elevator system will cause doors to open.

2.17 NOT USED

2.18 SENSOR AND CONTROL WIRE SURGE PROTECTION

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected as shown against surges induced on control and sensor wiring installed outdoors. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.19 COMMUNICATIONS LINKS SURGE PROTECTION

Communications equipment shall be protected against surges induced on any communications link. Cables and conductors, except fiber optics, which serve as communications links from Motor Control Room (MCR) to field equipment, and between field equipments shall have surge protection circuits installed at each end. Protection shall be furnished at equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 1 m of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.20 COMMUNICATIONS LINKS OVER VOLTAGE PROTECTION

Communications equipment such as MODEMs, line drivers, and repeaters shall be protected against overvoltage on any communications link conductors. Cables and conductors, which serve as communications links, except fiber optics, shall have overvoltage protection for voltages up to 480 Vac rms, 60 Hz installed. Instrument fuses or fusible resistors are required for this application.

2.21 FIREFIGHTERS SERVICE

Firefighter service shall be in accordance with ASME A17.1 for automatic elevators. Elevator lobby and machine room smoke detectors shall be photoelectric spot-type smoke detectors. Smoke detectors shall be powered from the building fire alarm control panel. Elevator lobby and machine room smoke detectors shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

2.22 ELEVATOR POWER UNIT

2.22.1 Pumping and Control Mechanism

Hydraulic fluid shall be provided in the reservoir, pump and control valve. Hydraulic fluid shall have a minimum fire point of 190 degrees C (375

degrees F) as established by ASTM D 92. If oil temperature drops below pre-set minimum, elevator shall be dispatched automatically to lowest terminal floor at which point the pump will bypass oil in system without car motion until pre-set temperature is reached. Normal response to passenger demand shall not be affected by this control. Resistance type heating elements do not meet the intent of this specification.

2.22.1.1 Oil Temperature Device

An oil temperature device shall be provided that will maintain oil temperature between 21 degrees C (70 degrees F) and 38 degrees C (100 degrees F) regardless of ambient temperatures.

2.22.1.2 Pump

Pump shall be a rotary-positive displacement type for oil-hydraulic elevator service designed for steady discharge with minimum pulsation to give smooth and quiet operation, with an output which will not vary more than 10 percent between no-load and full-load on the elevator. Operating pressure shall not exceed 2760 kPa (400 psi).

2.22.1.3 Piping

Piping shall be ASTM A 53/A 53M Grade E or S, ASTM A 106 Grade B, or grooved piping system of minimum schedule 40 seamless steel conforming to ASME A17.1 and ASME B16.11. Pipes shall conform to the cleanliness requirements of ASME B31.1.

2.22.1.4 Motor

Motor shall be especially designed for oil-hydraulic elevator service and shall be of standard manufacture duty rating and provided with specified speeds and loads.

2.22.1.5 Oil-Control Unit

Oil-control unit shall contain the following valve assemblies:

a. Automatic shut-off valve shall be provided in the oil-supply line as close to the cylinder inlet as possible. When there is a 10 percent drop in NO-LOAD operating pressure, the automatic shut-off valve shall be activated. When activated, the device shall immediately stop the descent of elevator and hold the elevator until it is lowered by use of the maximum lowering feature of the valve. Manual lowering feature of automatic shut-off valve shall be arranged to limit the maximum descending speed of elevator to 0.08 m/s (15 feet per minute). Exposed adjustments of automatic shut-off shall have the means of adjustment sealed after being set to the correct position.

b. Relief-valve for hydraulic shall be externally adjustable and shall bypass the total oil flow without increasing back pressure by more than 56 percent above working pressure.

c. Safety check-valve shall close quietly without permitting any perceptible reverse flow and shall be designed to support the elevator on a positively locked column of oil when car is at rest.

d. Up-start and stop valve shall be externally adjustable and shall bypass oil flow during the start-and-stop of motor-pump assembly. Valve shall close slowly, gradually diverting oil to the jack unit to insure smooth up-start and up-step.

e. Lowering and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth down-starts and stops. Leveling valve shall be designed to level the car to floor in the direction the car is traveling when slowdown is initiated.

f. Manual lowering valve shall be capable of lowering the elevator car in event of power failure. Manual-lowering valve shall be arranged to limit the maximum descending speed under manual operation to 0.08 m/s (15 fpm).

g. A service check-valve shall be installed in oil supply line between power unit and jack.

2.22.1.6 Storage Tank

Storage tank shall be single-wall construction of steel with a steel cover. Manufacturer's recommendation for the type of oil to be used shall be included in written instructions for the care, adjustment and maintenance of equipment.

2.22.1.7 Controller

Electric controller shall be of the microprocessor based logic type with battery backup provided with reduced voltage starting. Components required for proper elevator performance shall be neatly mounted and wired and completely enclosed in a cabinet with a mechanically-latched door. Control cabinet shall be designed for mounting on power unit, wall or floor stand. Electric control apparatus shall be completely isolated from oil reservoir. A feature shall be incorporated in electrical control circuit which will cause elevator car to descent automatically to the lowest terminal landing, if the system runs low on oil during ascending of the car. If power-operated doors are used, the car and hoistway doors shall automatically open when car reaches landing to allow passengers to exit. Parked car shall have doors in closed position and all control buttons shall be made inoperative.

2.22.2 Sound Reduction

Sound-insulating panels shall isolate airborne noise from motor pump assembly. Openings shall be provided to adequately ventilate the power unit motor. A minimum of two sound-isolating couplings shall be installed in oil line in machine room between pump and jack. Couplings shall be designed and manufactured to be blowout proof. Oil-hydraulic silencer shall be installed in oil line near power unit and shall contain pulsation

absorbing material surrounded by a blowout-proof housing. Power unit assembly shall be mounted on vibration pads to isolate the unit from building structure.

2.23 LEVELING DEVICE

Elevators shall be equipped with a 2-way leveling device to automatically bring the car to floor landings. Car shall automatically re-level at each landing to correct the overtravel and undertravel, and maintain the level regardless of load on car. Electric stopping system shall be arranged so that the car will stop level with the floor before brake is set. Stopping accuracy shall not exceed a plus or minus 6 mm.

2.24 JACK UNIT

Jack unit shall be designed and constructed of sufficient size to lift the gross load to the height specified and shall be free from oil leakage. Brittle material such as grey cast iron shall not be used in jack construction. Jack unit shall consist of the following:

a. Direct displacement plunger fabricated of heavy seamless steel tubing accurately turned and polished.

b. Stop-ring welded or screwed to the plunger to positively prevent plunger from leaving the cylinder.

c. Internal guide bearing.

d. Packing or seal.

e. Drip ring around cylinder top.

f. Outer cylinder made of steel tubing.

g. Air bleeder.

h. Brackets welded to jack cylinder for supporting the elevator on pit channels.

i. Scavenger pump with copper tubing connected to the tank.

2.25 ELEVATOR SUPPORTS

Structural steel beams, inserts, brackets, bolts and fastening devices shall be provided for proper installation of elevator equipment. Wood plugs are not acceptable.

2.26 BUFFERS

Buffers shall be of design suitable for depth of pit. Buffer anchorage at pit floors shall be provided for each car and counterweight and arranged to avoid puncturing the pit waterproofing. Type of buffer used shall be tested and approved for compliance with elevator service requirements before installation. Pipe struts and steadiers shall be provided as

required for pit conditions. A metal plate with information concerning stroke and load-rating shall be permanently fastened to each buffer. Pit-mounted buffers shall have an adequate stroke designed to bring the fully-loaded car and counterweight to rest from governor tripping speed at an average rate of retardation not exceeding gravity. Moving portion of buffer shall be designed to be accelerated by the car without noticeable peak retardation. Spring buffers shall be in accordance with ASME A17.1 A17.1.

2.27 LUBRICATION POINTS

Every part subject to movement friction shall be provided with provisions for oil or grease lubrication. All points of lubrication shall be readily accessible.

2.28 SEISMIC REQUIREMENTS

Seismic protection shall be provided in conformance with TI 809-04 for general guidance and computation of forces (1.O G horizontal and 1.0 G vertical minimum), ASME A17.1, Rule XXIV, and ICBO Building Code. The Contractor shall hire a registered engineer to submit the stamped calculations and drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Elevators and equipment shall be installed in accordance with ASME A17.1 and manufacturer's recommendation. Guide rails shall be set plumb and parallel and attached to guide rail brackets secured to building structure as indicated and at intervals not exceeding 3.8 m. Steel shim plates shall be used for aligning equipment. Guide rail sections shall be joined together in accordance with ASME A17.1. Guide rails shall be thoroughly cleaned and made smooth before elevator is put into operation. During installation all stainless steel shall be protected.

3.2 FIELD WELDING

When structural or load-bearing members are to be field welded, welding and qualification of welders shall be as specified in Section 05090 WELDING, STRUCTURAL.

3.3 CASING, CYLINDER AND PLUNGER UNIT

A steel casing minimum 200 mm larger in diameter than the cylinder sealed at bottom with steel plate or concrete plug shall be complete with provisions to accommodate a double wall cylinder. Casing shall be accurately positioned, plumbed and set to accept the cylinder. The cylinder shall be protected from corrosion by totally enclosing the cylinder with a separate schedule 80, polyvinyl chloride jacket or with a high density, fused polyethylene coating, recommended by the manufacturer. Area between casing and cylinder wall shall be filled with washed dry sand after cylinder has been accurately located. Top of casing shall be sealed.

The work of boring the well and setting the cylinder shall be coordinated with construction of concrete pit.

3.4 ELEVATOR WIRING

Wiring shall be provided for electrically-operated items of elevator equipment to comply with requirements of NFPA 70 and Section 16415 ELECTRICAL WORK, INTERIOR. For control and signal circuits wire shall be minimum No. 18 AWG. For power and lighting circuits wire shall be minimum No. 12 AWG. Work light fixtures equipped with 150 watt incandescent lamps and ground duplex receptacles shall be provided at top and bottom of car. Work light fixtures and traveling cable junction boxes shall be located to provide illumination at junction boxes. Wiring shall terminate in junction boxes. Wires shall be identified and shall match symbols shown on wiring diagrams. Control and signal wires shall be brought to accessible numbered terminal blocks on the controller. Intra-panel wiring shall be flame-resistant type.

3.4.1 Traveling Cables

Cables shall terminate at numbered terminal blocks in car and machine room. Traveling cable shall be provided with a separate shielded circuit for communication system and hang to obtain proper size of loop. Traveling cable shall be provided with 10 percent spare conductors for each car.

3.5 PAINTING AND PIPE COLOR CODE MARKING

Except for factory-finished items and corrosion-resistant items, machined surfaces shall be painted as specified in Section 09900 PAINTING, GENERAL.Color Code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.6 TESTING

Testing shall be in accordance with requirements of ASME A17.1and ASME A17.2.2; and as specified below. The Contractor shall conduct a complete test of the system. The Contractor shall provide the services of an elevator inspector, employed by an independent testing company to inspect the elevators, witness the final testing and certify the elevators. The inspector shall meet all qualification requirements of ASME QEI-1 and shall be certified in accordance with ASME QEI-1. The Contractor shall provide an elevator certificate signed by the inspector for each elevator. The certificate shall be provided to the Contracting Officer within 30 day after the completion of all testing.

3.6.1 Testing Period

Each elevator shall be tested with the specified rated-load in car continuously for a period of 35 percent of the duty time. During the test run the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor. A manual test of the final limits (UP and DOWN overtravel) shall also be performed.

3.6.2 Speed Load Testing

The actual speed of elevator car in both directions of travel shall be determined with the rated-load and with no-load in the elevator car. Actual measured speed of car with the rated-load in the UP direction shall be within 10 percent of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined shall not exceed 10 percent of the total difference between the UP and DOWN speeds.

3.6.3 Car Leveling Testing

Elevator car-leveling devices shall be tested for accuracy of landing at all floors with no-load in car, with symmetrical load in car and with the rated-load in car in both directions of travel.

3.6.4 Temperature Rise Testing

Temperature rise of hydraulic pump motor, motor drive, exciter and booster shall be conducted during the full-load test run for minimum one hour. Under these conditions, temperature rise of equipment shall not exceed the requirements established in NEMA MG 1 Chapter 12. Test shall be started when all parts of equipment are within the temperature required by NEMA at time of starting tests.

3.6.5 Insulation-Resistance Testing

Insulation-resistance testing shall be performed to ensure that the complete elevator wiring systems will be free from short circuits and grounds. Electrical conductors shall have an insulation-resistance of not less than 1 megohm between each conductor and ground, and not less than 1 megohm between each conductor and all other conductors. Prior to testing, provisions shall be made to prevent damage to electronic devices.

3.7 FRAMED INSTRUCTIONS

Two sets of instructions shall be typed and framed under glass or in laminated plastic, and posted side-by-side in the elevator room where directed before acceptance of elevator systems. First set of instructions shall include wiring and control diagrams showing the complete layout of elevator system. Second set of instructions shall include the condensed operating instructions describing preventive maintenance procedures, the methods for checking the elevator system for normal safe operation, and the procedures for safely starting and stopping the elevator system.

3.8 OPERATOR TRAINING

Contractor shall conduct a formal training course for operating Government personnel which shall include care, lubrication, adjustment and maintenance of elevator equipment. Training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. Field instructions shall cover all of the items contained in the operating and maintenance instructions, including demonstrations of routine maintenance operations. Contracting Officer shall be notified at least 14 days prior to date of starting the training course.

-- End of Section --

SECTION 15080A

THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM B 209M	(2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1126	(1998) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(1995) Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(1995) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1999) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Pipe Insulation

ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 553	(1999) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 610	(1999) Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C 612	(2000) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 795	(1992; R 1998el) Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	(1985; R 1996el) Adhesives for Duct Thermal Insulation
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 921	(1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1993) National Commercial & Industrial Insulation Standards

1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets , facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Thermal Insulation Materials; G, RE.

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.1.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

2.1.2 Contact Adhesive

Adhesive may be dispersed in a nonhalogenated organic solvent or, dispersed in a nonflammable organic solvent which shall not have a fire point below 94 degrees C. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 100 degrees C. The adhesive shall be nonflammable and fire resistant.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.4060 mm (0.016 inch) aluminum 25 x 25 mm with factory applied kraft backing. Aluminum shall be ASTM B 209M , Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449/C 449M. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 100 mm wide rolls.

2.1.7 Staples

Outward clinching type monel or ASTM A 167, Type 304 or 316 stainless steel. Monel is a nickel rich alloy which has high strength, high ductility, and excellent resistance to corrosion.

2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 6.1 N/mm (35 pounds/inch) width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 3.5 N/mm width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials which require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.1.8.1 White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.1.8.2 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.4060 mm nominal thickness; ASTM B 209M , Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.3960 mm thick, 12.7 mm wide for pipe under 300 mm diameter and 19.1 mm (3/4 inch) wide for pipe over 300 mm and larger diameter. Aluminum jacket circumferential seam bands shall be 50.8 x 0.4060 mm aluminum matching jacket material. Bands for insulation below ground shall be 19.1 x 0.5080 mm thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburg or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.7620 mm.

2.1.9 Vapor Retarder Coating

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.1.9.1 Vapor Retarder Required

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.9.2 Vapor Retarder Not Required

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.10 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 34 degrees to plus 16 degrees C for outdoor, indoor, exposed or concealed applications, shall be as follows:

a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory applied jacket.

b. Flexible Elastomeric Cellular Insulation:ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.

c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory applied jacket.

d. Mineral Fiber: ASTM C 547

e. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory applied jacket.

2.2.2 Aboveground Hot Pipeline

Insulation for above 16 degrees C , for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturers recommended factory applied jacket.

a. Mineral Fiber: ASTM C 547, Types I, II or III, supply the insulation with manufacturers recommended factory applied jacket.

b. Calcium Silicate: ASTM C 533, Type I indoor only, or outdoors above 121 degrees C pipe temperature.

c. Cellular Glass: ASTM C 552, Type II and Type III. Supply the insulation with manufacturers recommended factory applied jacket.

d. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II to 93 degrees C service.

e. Phenolic Insulation: ASTM C 1126 Type III to 121 C service shall comply with ASTM C 795. Supply the insulation with manufacturers recommended factory applied jacket.

f. Perlite Insulation: ASTM C 610

g. Polyisocyanurate Insulation: ASTM C 591, Type 1, to 149 degrees C service. Supply the insulation with manufacturer's recommended factory applied jacket.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Rigid Mineral Fiber

ASTM C 612, Type IA, IB, II, III, & IV.

2.3.2 Flexible Mineral Fiber

ASTM C 553, Type I,or Type II up to 121 C . ASTM C 1290 Type III.

2.3.3 Cellular Glass

ASTM C 552, Type I.

2.3.4 Phenolic Foam

ASTM C 1126 Type II, shall comply with ASTM C 795.

2.3.5 Flexible Elastomeric Cellular

ASTM C 534 Type II.

2.3.6 Polyisocyanurate

ASTM C 591, Type 1. Supply the insulation with manufacturer's recommended factory applied jacket.

2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.4.1 Cold Equipment Insulation

For temperatures below 16 degrees C.

2.4.1.1 Cellular Glass

ASTM C 552, Type I, Type III, or Type IV as required.

2.4.1.2 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II.

2.4.1.3 Phenolic Foam

ASTM C 1126 Type II shall comply with ASTM C 795.

2.4.1.4 Polyisocyanurate Foam

ASTM C 591, Type I. Supply the insulation with manufacturer's factory applied jacket.

2.4.2 Hot Equipment Insulation

For temperatures above 16 degrees C.

2.4.2.1 Rigid Mineral Fiber

ASTM C 612, Type IA, IB, II, III, IV, or V as required for temperature encountered to 982 degrees C.

2.4.2.2 Flexible Mineral Fiber

ASTM C 553, Type I, II, III, IV, V, VI or VII as required for temperature encountered to 649 degrees C.

2.4.2.3 Calcium Silicate

ASTM C 533, Type I, indoors only, or outdoors above 121 degrees C. Pipe shape may be used on diesel engine exhaust piping and mufflers to 649 degrees C.

2.4.2.4 Cellular Glass

ASTM C 552, Type I, Type III, or Type IV as required.

2.4.2.5 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II, to 93 degrees C.

2.4.2.6 Phenolic Foam

ASTM C 1126 Type II to 121 degrees C. shall comply with ASTM C 795.

2.4.2.7 Molded Expanded Perlite

ASTM C 610.

2.4.2.8 Polyisocyanurate Foam:

ASTM C 591, Type I. Supply the insulation with manufacturer's recommended factory applied jacket.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be

compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after one hour period; any insulation found to pull apart after one hour shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds standard plates except where modified herein or on the drawings.

3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07840A FIRESTOPPING.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 93 degrees C. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written

approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. Where penetrating interior walls, the aluminum jacket shall extend 50 mm beyond either side of the wall and shall be secured on each end with a band.

d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 250 mm above the floor with one band at the floor and one not more than 25 mm from the end of the aluminum jacket.

e. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 50 mm beyond the interior surface of the wall.

f. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 50 mm down

beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

g. For hot water pipes supplying lavatories or other similar heated service which requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 2.0 mm applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 50.0 mm and shall seal the end of the insulation. Glass tape seams shall overlap 25 mm . Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 10 mm .

h. For domestic cold water pipes supplying lavatories or other similar cooling service which requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 2.0 mm . The coating shall extend out onto the insulation 50.0 and shall seal the end of the insulation. Caulk the annular space between the outer surface of the pipe insulation and the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 10 mm .

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 50 mm and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 50 mm shall be installed.

b. Horizontal pipes larger than 50 mm at 16 degrees C and above shall be supported on hangers in accordance with MSS SP-69, and Section 15400A PLUMBING, GENERAL PURPOSE.

c. Horizontal pipes larger than 50 mm and below 16 degrees C shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass or calcium silicate or perlite (above 27 C shall be installed above each shield. The insert shall cover not less than the bottom 180 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 50 mm on each end beyond the protection shield. When insulation inserts are

required per the above, and the insulation thickness is less than 25 mm, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 50 mm on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 25 mm, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 9 m, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 38 mm, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 150 mm and less. Type II sheet insulation used on pipes larger than 150 mm shall not be stretched around the pipe. On pipes larger than 300 mm, adhere insulation directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 1.8 m level shall be protected.

3.2.2 Aboveground Cold Pipelines

The following cold pipelines shall be insulated per Table I minus 34 degrees C to plus 16 degrees C:

a. Domestic cold water.

b. Make-up water.

c. Refrigerant suction lines.

d. Chilled water.

e. Air conditioner condensate drains.

f. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness
Pipe Size (mm)

Type of Service	Material	Runouts up to 50 mm*	25 mm & less	30 50 mm	65 - 100 mm	125 - 150 mm
Refrigerant suction piping	CG		40	40	40	40
	FC		25	25	25	25
	PF		40	40	40	40 40
	PC		25	25	25	25
Chilled water supply & return	CG	40	40	40	50	50
	FC	15	25	25	25	25
	PF	40	40	40	40	40 40
	PC	25	25	25	25	25
Cold domestic water, above and below ceilings, & make up water	CG	40	40	40	40	40
	FC	10	10	10	10	10
	PF	40	40	40	40	40 40
	PC	25	25	25	25	25
Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap	FC	15	15	15	15	20
	MF	15	25	25	40	40

Table I - Cold Piping Insulation Thickness
Pipe Size (mm)

Type of Service personnel	Material	Runouts up to 50 mm*	25 mm & less	30 50 mm	65 - 100 mm	125 - 150 mm
Air conditioning condensate drain located inside building	FC	10	15	15	N/A	
	PF	40	40	40	N/A	
	PC	25	25	25	N/A	

*When runouts to terminal units exceed 3.66 m the entire length of runout shall be insulated like the main feed pipe.

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular
PC - Polyisocyanurate Foam

3.2.2.2 Jacket for Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building shown to be protected with an aluminum jacket shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 1.8 m level will be protected.

3.2.2.3 Insulation for Straight Runs (Mineral Fiber, Cellular Glass, Phenolic Foam and Polyisocyanurate Foam)

a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with a vapor retarder coating.

b. Longitudinal laps of the jacket material shall overlap not less than 38 mm. Butt strips 75 mm wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 100 mm centers if not factory self-sealing. If staples are used, they shall be sealed per paragraph 3.2.2.3 e.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees and 50 degrees C during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating. The patch shall extend not less than 38 mm past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be coated with vapor retarder coating.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 50 mm or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of vapor retarder coating with a minimum total thickness of 2.0 mm, applied with glass tape embedded between coats. Tape seams shall overlap 25 mm.The coating shall extend out onto the adjoining pipe insulation 50 mm. Fabricated insulation with a factory vapor retarder jacket shall be protected with two coats of vapor retarder coating with a minimum thickness of 2 mm and with a 50 mm wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed

with a vapor retarder coating and a 100 mm wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 150 mm from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

The following hot pipelines above 16 degrees C shall be insulated per Table II:

a. Domestic hot water supply & recirculating system.

c. Compressed air discharge.

d. Hot water heating.

3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
CS - Calcium Silicate
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular
PL - Perlite
PC - Polyisocyanurate Foam

Table II - Hot Piping Insulation Thickness
Pipe Size (mm)

Type of Service (degrees C)	Material	Runouts up to 50 mm*	25 mm & less	32 - 50 mm	65 - 100 mm	125 - 150 mm
Hot domestic water supply & recirculating system	CG	40	40	40	40	40
	FC	15	25	25	40	40
	PF	15	25	25	25	25
	MF	15	40	40	40	40
	PC	25	25	25	25	25
Compressed Air discharge	CG		40	50	50	50
	PF		25	25	25	25
	MF		40	40	50	50
	CS/PL		40	50	65	65
	PC		25	25	25	25
Heating hot water, supply & return	CG	40	40	50	50	65
	PF	15	25	25	25	25
	MF	15	40	40	50	65
	CS/PL	25	40	50	65	65
	PC	25	25	25	25	25

* When runouts to terminal units exceed 3.66 m, the entire length of runout shall be insulated like the main feed pipe.

** Applied to recirculating sections of service or domestic hot water systems and first 2.4 meters from storage tank for non-recirculating systems.

3.2.3.2 Jacket for Insulated Hot Pipe, Except Pipe Insulated with Flexible Elastomeric Cellular

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

3.2.3.3 Insulation for Straight Runs

a. Insulation shall be applied to the pipe with joints tightly butted.

b. Longitudinal laps of the jacket material shall overlap not less than 38 mm, and butt strips 75 mm wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 100 mm centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees and 49 degrees C and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is nonadhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. Breaks and punctures in the jacket material shall be patched by either wrapping a strip of jacket material around the pipe and securing with adhesive and staple on 100 mm centers (if not factory self-sealing), or patching with tape and sealing with a brush coat of vapor retarder coating. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 38 mm past the break.

f. Flexible elastomeric cellular pipe insulation shall be installed by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 150 mm shall not be stretched around the pipe. On pipes larger than 300 mm, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.3.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates, except as modified herein: 5 for anchors; 10, 11, 12,and 13 for fittings; 14, 15 and 16 for valves; 17 for flanges and unions; and 18 for couplings. Insulation shall be the same as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 50 mm or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of adhesive

applied with glass tape embedded between coats. Tape seams shall overlap 25 mm. Adhesive shall extend onto the adjoining insulation not less than 50 mm. The total dry film thickness shall be not less than 2.0 mm.

d. Insulation terminations shall be tapered to unions at a 45-degree angle.

e. At the option of the Contractor, factory premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 50 mm at longitudinal and circumferential joints and shall be secured with bands at not more than 300 mm centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 16 degrees C and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 16 degrees C and below abuts an uninsulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 16 degrees C shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 25 mm and the adjoining aluminum jacket not less than 50 mm. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III.

Table III - Minimum Duct Insulation (mm)

Cold Air Ducts	50
Relief Ducts	40
Fresh Air Intake Ducts	40
Warm Air Ducts	50
Relief Ducts	40
Fresh Air Intake Ducts	40

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 25 mm, and maximum thickness for polyisocyanurate foam insulation shall not exceed 40 mm to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 1 inch and maximum thickness for polyisocyanurate foam insulation shall not exceed 1.5 inch, to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50.

3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Mixed air ducts.

c. Relief ducts.

d. Flexible runouts (field-insulated).

e. Plenums.

f. Coil headers and return bends.

g. Coil casings.

h. Fresh air intake ducts.

i. Ducts exposed to weather or non-conditioned spaces.

j. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 12 kg per cubic meter and rigid type where exposed, minimum density 48 kg per cubic meter. Insulation for round/oval ducts shall be flexible type, minimum density 12 kg per cubic meter with a factory Type I or II jacket; or, a semi rigid board, minimum density 48 kg per cubic meter, , formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I or II all service jacket. Insulation for exposed ducts shall be provided with either a white, paintable, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Insulation on concealed duct shall be provided with a factory-applied Type I or II vapor retarder jacket. The total dry film thickness shall be approximately 2.0 mm.. Duct insulation shall be continuous through sleeves and prepared openings except fire wall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any uninsulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 150 mm wide strips on 300 mm centers.

b. For rectangular and oval ducts, 600 mm (24 inches) and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 400 mm centers and not more than 400 mm from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 400 mm centers and not more than 400 mm from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 50 mm. The insulation shall not be compressed to a

thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 50 mm beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and uninsulated surface 50 mm. Pin puncture coatings shall extend 50 mm from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 300 mm apart and not more than 75 mm from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 300 mm and larger. One row shall be provided for each side of duct less than 300 mm.

b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed or bent over.

d. Joints in the insulation jacket shall be sealed with a 100 mm wide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 50 mm beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 50 mm. Pin puncture coatings shall extend 50 mm from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 12 kg per cubic meter, attached as per MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Mixed air ducts

c. Relief air ducts

d. Flexible runouts (field insulated)

e. Plenums

f. Fresh air intake ducts

g. Ducts exposed to weather or non-conditioned spaces.

h. Ducts for dual purpose (hot/cold air) treat as cold air duct.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 12 kg per cubic meter; and rigid type where exposed, minimum density 48 kg per cubic meter. Insulation on exposed ducts shall be provided with a white, paintable, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, minimum density 12 kg per cubic meter with a factory-applied

Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 2.0 mm Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 150 mm wide strips on 300 mm centers.

b. For rectangular and oval ducts 600 mm and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 450 mm centers and not more than 450 mm from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 450 mm centers and not more than 450 mm from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 50 mm at joints and the lap shall be secured and stapled on 100 mm centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 400 mm apart and not more than 150 mm from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 300 mm and larger and a minimum of one row for each side of duct less than 300 mm.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over

the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin excess clipped and bent over.

d. Joints on jacketed insulation shall be sealed with a 100 mm wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 50 mm beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 12 kg per cubic meter attached by staples spaced not more than 400 mm and not more than 150 mm from the degrees of joints. Joints shall be sealed in accordance with paragraph 3.3.3.2 d.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 16 degrees C, ducts shall be insulated as specified for cold air duct.

3.3.5 NOT USED

3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.7 Duct Exposed to Weather

3.3.7.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.7.2 Round Duct

Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 75 mm and secured with bands located at circumferential laps and at not more than 300 mm intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an uninsulated surface, joints shall be sealed with caulking.

3.3.7.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.7.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 2.0 mm minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment which must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Handholes.

b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

3.4.1.1 Test Ports

All manual damper operators, balance test ports on pumps, balance valves, triple duty valves, venturis and similar devices shall be accessible to the balance contractor without dismantling insulation or jacketing. Provide removable insulation sections at these devices or extend the ports to exterior of the insulation.

3.4.2 Insulation for Cold Equipment

Cold equipment below 16 degrees C: Insulation shall be furnished on equipment handling media below 16 degrees C including the following:

a. Pumps.

b. Refrigeration equipment parts that are not factory insulated.

c. Drip pans under chilled equipment.

d. Cold water storage tanks.

e. Cold and chilled water pumps.

f. Air handling equipment parts that are not factory insulated.

g. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

a. Equipment handling media between 2 and 16 degrees C: 40 mm thick cellular glass, 25 mm thick flexible elastomeric cellular, 40 mm thick phenolic foam, or 25 mm thick polyisocyanurate foam.

b. Equipment handling media between minus 18 degrees C and plus 1 degrees C: 75 mm thick cellular glass, 40 mm flexible elastomeric cellular, 40 mm thick phenolic foam, or 40 mm thick polyisocyanurate foam.

c. Equipment handling media between minus 34 degrees C and minus 18 degrees C: 90mm thick cellular glass 45 mm thick flexible elastomeric cellular, 40 mm thick phenolic foam, or 40 mm thick polyisocyanurate foam.

3.4.2.2 Pump Insulation

a. Pumps shall be insulated by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints which do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid insulation and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Exposed insulation corners shall be protected with corner angles.

c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Caulking shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To

ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 300 mm centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Cellular glass and phenolic foam insulation shall be set in a coating of bedding compound, and joints shall be sealed with bedding compound as recommended by the manufacturer.

d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm.

e. Exposed insulation corners shall be protected with corner angles.

f. Insulation on equipment with ribs shall be applied over 150 x 150 mm by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 50 x 50 mm washers or shall be securely banded or wired in place on 300 mm centers.

3.4.2.4 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 2.0 mm. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 16 degrees C including the following:

a. Hot water generators.

b. Water heaters.

c. Pumps handling media above 54 degrees C.

d. Hot water storage tanks.

e. Air separation tanks.

f. Unjacketed boilers or parts of boilers.

g. Boiler flue gas connection from boiler to stack (if inside).

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table IV:

Legend

RMF: Rigid Mineral Fiber
FMF: Flexible Mineral Fiber
CS: Calcium Silicate
PL: Perlite
CG: Cellular Glass
FC: Flexible Elastomeric Cellular
PF: Phenolic Foam
PC: Polyisocyanurate Foam

TABLE IV
Insulation Thickness for Hot Equipment (mm)

Equipment handling steam or other media to indicated pressure or temperature limit	Material	Thickness
103.4 kPa	RMF	50 mm
or	FMF	50 mm
121 C	CS/PL	100 mm
	CG	75 mm
	PF	40 mm
	FC(<93 C)	25 mm
	PC	25 mm
1379.0kPa	RMF	75 mm
or	FMF	75 mm
204 C	CS/PL	100 mm
	CG	100 mm

316 C: Thickness necessary to limit the external temperature of the insulation to 50 C, except that diesel engine exhaust piping and mufflers shall be covered with 150 mm thick material suitable for 650 degrees C service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

3.4.3.2 Insulation of Pumps

Pumps shall be insulated by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints which do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing which does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 2.0 mm. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 300 mm centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.

d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

e. Exposed insulation corners shall be protected with corner angles.

f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 150 x 150 mm by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 50 x 50 mm washers or shall be securely banded or wired in place on 300 mm (maximum) centers.

g. On equipment handling media above 316 degrees C, insulation shall be applied in two or more layers with joints staggered.

h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the

finish shall be 2.0 mm. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 16 degrees C: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 1112 N walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

-- End of Section --

SECTION 15181R

CHILLED WATER PIPING AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 182/A 182M	(1999) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(1999a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 536	(1984; R 1999el) Ductile Iron Castings
ASTM A 653/A 653M	(1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 733	(1999) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 32	(1996) Solder Metal
ASTM B 62	(1993) Composition Bronze or Ounce Metal

	Castings
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM F 1120	(1987; R 1998) Circular Metallic Bellows Type Expansion Joints for Piping Application
ASTM F 1199	(1988; R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

ASME B31.1	(1998) Power Piping
ASME B31.9	(1996) Building Services Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS Brazing Hdbk	(1991) Brazing Handbook
AWS D1.1	(2000) Structural Welding Code - Steel
AWS Z49.1	(1999) Safety in Welding and Cutting

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(1994) Centrifugal Pumps

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(1998) Motors and Generators
NEMA MG 2	(1989) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Piping System; G, RE

Drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Piping layouts which identify all valves and fittings.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Piping layouts showing all anchor, guide and any other required expansion compensator location. These drawings shall be

stamped by a professional engineer.

SD-03 Product Data

Piping System; G, RE

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be provided for the following components as a minimum:

a. Piping and Fittings

b. Valves and Accessories

c. Expansion Joints

d. Pumps

e. Expansion Tanks

f. Air Separator Tanks

g. Pipe Hangers, Inserts, and Supports

Water Treatment Systems

Six complete copies, at least 5 weeks prior to the purchase of the water treatment system, of the proposed water treatment plan including a layout, control scheme, a list of existing make-up water conditions including the items listed in paragraph "Water Analysis", a list of chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

Spare Parts

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Qualifications

4 copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations.

Field Tests

A schedule, at least 2 weeks prior to the start of related testing, for each test. The schedules shall identify the proposed date, time, and location for each test.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

SD-06 Test Reports

Field Tests

Six copies of the report shall be provided in bound 216 x 279 mm (8 1/2 x 11 inch) booklets. Reports shall document all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

SD-07 Certificates

Service Organization

A certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Operation Manuals; G, RE

Six complete copies of an operation manual in bound 216 x 279 (81/2 x 11 inch) booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manuals; G, RE

Six complete copies of maintenance manual in bound 216 x 279 (81/2 x 11 inch) booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping layouts and simplified wiring and control diagrams of the system as installed.

1.3 QUALIFICATIONS

Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply the personally assigned symbol near each weld made, as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.4 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

1.5 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.6.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer

regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 746 kW (1 hp) and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 PIPING SYSTEM

System design, component selection, and system installation, including pressure containing parts and material, shall be based upon a minimum

service pressure of 862 kPa at 66 degrees C ; minimum ANSI Class 125. Chilled water piping shall be steel pipe with the exception that piping 100 mm and smaller may be copper tubing.

2.5 STEEL PIPE

Steel pipe shall conform to ASTM A 53/A 53M, Schedule 40, Type E or S, Grades A or B. Type F pipe shall not be used.

2.5.1 Fittings and End Connections (Joints)

Fittings and end connections shall be as defined herein, except as identified elsewhere. Piping and fittings 25 mm (1 inch) and smaller shall have threaded connections. Piping and fittings larger than 25 mm (1 inch) and smaller than 80 mm (3 inches) shall have either threaded, grooved, or welded connections. Piping and fittings 80 mm (3 inches) and larger shall have grooved, welded, or flanged connections. Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 110 degrees C . Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting in accordance with MSS SP-25.

2.5.1.1 Threaded Connections

Threaded valves and pipe connections shall conform to ASME B1.20.1. Threaded fitting shall conform to ASME B16.3. Threaded unions shall conform to ASME B16.39. Threaded pipe nipples shall conform to ASTM A 733.

2.5.1.2 Flanged Connections

Flanges shall conform to ASTM A 182/A 182M and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1.59 mm (1/16 inch) thickness, full face or self-centering flat ring type. These gaskets shall contain aramid fibers bonded with styrene butadeine rubber (SBR) or nitrile butadeine rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193/A 193M.

2.5.1.3 Welded Connections

Welded valves and pipe connections (both butt-welds and socket-welds types) shall conform to ASME B31.9. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11. Welded fittings shall be identified with the appropriate grade and marking symbol.

2.5.1.4 Grooved Mechanical Connections

Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming ASTM A 106, Grade B or ASTM A 53/A 53M.

Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 110 degrees C (230 degrees F) or Grade No. M3BA610A15B44Z for circulating medium up to 93 degrees C (200 degrees F) . Grooved mechanical connections shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183. Pipe connections and fittings shall be the product of the same manufacturer.

2.5.1.5 Dielectric Waterways and Flanges

Dielectric waterways shall have a water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test. Dielectric waterways shall be constructed of galvanized steel and have threaded end connections to match connecting piping. Dielectric waterways shall be suitable for the required operating pressures and temperatures. Dielectric flanges shall provide the same pressure ratings as standard flanges and provide complete electrical isolation between connecting pipe and/or equipment as described herein for dielectric waterways.

2.6 COPPER PIPE

Copper pipe shall conform to ASTM B 88M , Type K or L.

2.6.1 Fittings and End Connections (Joints)

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M . Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.6.1.1 Grooved Mechanical Connections

Grooved mechanical joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C . Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183. Pipe connections and fittings shall be the product of the same manufacturer.

2.6.2 Solder

Solder shall conform to ASTM B 32, grade Sb5, tin-antimony alloy for service pressures up to 1034 kPa . Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

2.6.3 Brazing Filler Metal

Filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.7 VALVES

Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 3 m or higher above the floor. Valves in sizes larger than 25 mm (1 inch) and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.7.1 Gate Valve

Gate valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with rising stem and threaded, soldered, or flanged ends. Gate valves 80 mm (3 inches) and larger shall conform to MSS SP-70, Type I, II, Class 125, Design OF and shall be cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.7.2 Globe and Angle Valve

Globe and angle valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Globe and angle valves 80 mm (3 inches) and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged or threaded ends.

2.7.3 Check Valve

Check valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 80 mm (3 inches) and larger shall conform to MSS SP-71, Type I, II, III, or IV, Class 125 or 150 and shall be cast iron with bronze trim and flanged or threaded ends.

2.7.4 Butterfly Valve

Butterfly valves shall be in accordance with MSS SP-6, Type 1 and shall be wafer lug type. Valves shall be bubble tight at 1,000 kPa (150 psig). Valve bodies shall be cast iron, malleable iron, or steel. Valves smaller than 200 mm (8 inches) shall have throttling handles with a minimum of seven locking positions. Valves 200 mm (8 inches) and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.7.5 Plug Valve

Plug valves 50 mm (2 inches) and larger shall conform to MSS SP-78, have

flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 50 mm (2 inches) and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double-seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operated from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valve shall have weatherproof operators with mechanical position indicators. Valves 200 mm (8 inches) or larger shall be provided with manual gear operators with position indicators.

2.7.6 Ball Valve

Ball valves 15 mm (1/2 inch) and larger shall conform to MSS SP-72 or MSS SP-110 and shall be ductile iron or bronze with threaded, soldered, or flanged ends.

2.7.7 Calibrated Balancing Valve

Valve shall be calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valve's Cv rating shall be as indicated. Valve bodies shall be provided with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter, suitable for the operating pressure specified, shall be provided. The meter shall be complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer.

2.7.8 NOT USED

2.7.9 Pump Discharge Valve

Valve shall shall perform the functions of a nonslam check valve, a manual balancing valve, and a shutoff. Valve shall be of cast iron or ductile iron construction with bronze and/or stainless steel accessories. Valve shall have an integral pointer which registers the degree of valve opening. Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow. Valves smaller than 50 mm (2 inches) shall have NPT connections. Valves 50 mm (2 inches) and larger shall have flanged or grooved end connections. Valve design shall allow the back seat for the stem to be replaced in the field under full line pressure. Valve's Cv rating shall be as indicated.

2.7.10 NOT USED

2.7.11 NOT USED

2.7.12 Pressure Relief Valve

Valve shall prevent excessive pressure in the piping system when the piping

system reaches its maximum heat buildup. Valve shall be in accordance with ANSI Z21.22 and shall have cast iron bodies with corrosion resistant internal working parts. The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.

2.7.13 NOT USED

2.7.14 Drain Valves

Valves shall be the gate valve type which are in accordance with MSS SP-80. Valve shall be manually-operated, 20 mm pipe size and above with a threaded end connection. Valve shall be provided with a water hose nipple adapter.

2.7.15 Air Vents

Manually-operated general service type air vents shall be brass or bronze valves which are furnished with threaded plugs or caps. Automatic type air vents shall be the ball-float type with brass/bronze or brass bodies, 300 series corrosion-resistant steel float, linkage and removable seat. Air vents on water coils shall have not less than 3 mm threaded end connections. Air vents on water mains shall have not less than 20 mm threaded end connections. Air vents on all other applications shall have not less than 15 mm threaded end connections.

2.8 PIPING ACCESSORIES

2.8.1 Strainer

Strainer shall be in accordance with ASTM F 1199, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 0.8 mm (22 gauge) monel, with a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.8.1.1 Strainer Openings

For Pipe Size	Opening Size
Up to 50 mm (2")	.838 mm (.033")
65 mm to 100 mm (2 1/2" - 4")	1.575 mm (.062")
125 mm up (5" up)	3.175 mm (.125")

2.8.2 Combination Strainer and Suction Diffuser

Unit shall consist of an angle type body with removable strainer basket and straightening vanes, a suction pipe support, and a blowdown outlet. Strainer shall be in accordance with ASTM F 1199, except as modified herein. Unit body shall have arrows clearly cast on the sides indicating

the direction of flow.

2.8.2.1 Stainless Steel Strainer

Provide stainless steel combination diffusion-strainer-orifice cylinder with 4.76 mm (3/16") perforations. Provide startup strainer of 16 mesh bronze.

2.8.3 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 862 kPa (125 psig) or 1034 kPa (150 psig) service as appropriate for the static head plus the system head, and 120 degrees C, for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.8.4 Pressure and Vacuum Gauges

Gauges shall conform to ASME B40.1 Grade A 1% accuracy, and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 85 mm in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range. Gauge face shall be marked in both kPa and psig units. Gauge shall be liquid filled.

2.8.5 Temperature Gauges

Temperature gauges shall be ASTM B40.3 Grade A 1% accuracy. The industrial duty type and be provided for the required temperature range. Gauges shall have both Fahrenheit and Celsius scale in 1 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 1.5 m of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 1.5 to 2.1 m above the finished floor. Remote element type temperature gauges shall be provided in thermal wells located 2.1 m above the finished floor.

2.8.5.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 229 mm (9 inches) long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.8.5.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 89 mm (3-1/2 inches), stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

2.8.5.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 89 mm (3-1/2 inches), stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.8.5.4 Thermal Well

Thermal well shall be identical size, 15 or 20 mm (1/2 or 3/4 inch) NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 15 mm (1/2 inch) NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 25 mm .

2.8.6 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58 and MSS SP-69.

2.8.7 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.8.8 Expansion Joints

2.8.8.1 NOT USED

2.8.8.2 NOT USED

2.8.8.3 Bellows Type

Bellows expansion type joints shall be in accordance with ASTM F 1120 with Type 304 stainless steel corrugated bellows, reinforced with equalizing rings, internal sleeves, and external protective covers. Joint end connections shall be grooved, flanged, or beveled for welding. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint.

2.9 PUMPS

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.5. Pump capacity, efficiency, motor size, and impeller type shall be as indicated on the drawings. Pumps shall be

selected at or within 5 percent of peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor shall conform to NEMA MG 1, be open, and have sufficient wattage (horsepower) for the service required. Pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in the cover.

2.9.1 Construction

Shaft seal shall be mechanical-seal or stuffing-box type. Impeller shall be statically and dynamically balanced. Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 862 kPa (125 psig) . Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water. Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings. Pump shall have a coupling guard. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 3,600 rpm, except where the pump head is less than 180 kPa , the pump speed shall not exceed 1,750 rpm. Pump shall be accessible for servicing without disturbing piping connections.

2.9.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone separator in line.

2.9.3 Stuffing-Box Type Seals

Stuffing box shall include minimum 4 rows of square, impregnated TFE (Teflon) or graphite cord packing and a bronze split-lantern ring. Packing gland shall be bronze interlocking split type.

2.10 EXPANSION TANKS

Tank shall be welded steel, constructed, tested and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 862 kPa and precharged to the minimum operating pressure. Tank shall have a replaceable diaphragm and be the captive air type, except where scheduled otherwise. Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an

air charging valve, and system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.11 AIR SEPARATOR TANKS

External air separation tank shall have an internal design suitable for creating the required vortex and subsequent air separation. Tank shall be steel, constructed, tested, and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 862 kPa. Tank shall have tangential inlets and outlets connections, threaded for 50 mm and smaller and flanged for sizes 65 mm and larger. Air released from a tank shall be vented as indicated. Tank shall be provided with a blow-down connection.

2.12 WATER TREATMENT SYSTEMS

When water treatment is specified, the use of chemical-treatment products containing hexavalent chromium (Cr) is prohibited. Contractor shall conduct a water analysis of make up water as needed to establish water treatment regimen.

2.12.1 Chemical Pot Feeders

Provide a 5.7 liter (1.5 gal) chemical pot feeder for the chilled water system. Provide the feeders consisting of a welded steel body, funnel and funnel valve, air vent and drain petcocks and outlet valve. Pipe each feeder in a 3-way bypass across the pump so that the flow is in the bottom and out the top of the unit. Mount the unit on the wall not more than 1200 mm (48 inches) above the floor.

2.12.2 Chilled Water

Water to be used in the chilled water systems shall be treated to maintain the conditions recommended by this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Chemicals shall meet all required federal, state, and local environmental regulations for the treatment of evaporator coils and direct discharge to the sanitary sewer.

2.13 NOT USED

2.14 SUPPLEMENTAL COMPONENTS/SERVICES

2.14.1 Drain and Make-Up Water Piping

Make-up water piping and backflow preventers shall comply with the requirements of Section 15400 PLUMBING, GENERAL PURPOSE. Drains from fan coil units shall be copper pipe. Drains which connect to sanitary sewer system shall be connected by means of an indirect waste.

2.14.2 NOT USED

2.14.3 Field Applied Insulation

Field applied insulation shall be provided and installed in accordance with Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.1.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.1.2 Functional Requirements

Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall not be less than 2 mm in 1 m . Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 65 mm (2-1/2 inches) or less in diameter, and with flanges for pipe 80 mm (3 inches) and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges. Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation fittings shall be provided between dissimilar metals.

3.1.3 Fittings and End Connections

3.1.3.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show

after the joint is made.

3.1.3.2 Brazed Connections

Brazing shall be performed in accordance with AWS Brazing Hdbk, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.3.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.3.4 Grooved Mechanical Connections

Grooves shall be prepared in accordance with the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.3.6 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be

suitable for the intended application.

3.1.4 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.5 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

3.1.6 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.7 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

3.1.8 Temperature Gauges

Temperature gauges shall be located on coolant supply and return piping at each heat exchanger, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 25 mm .

3.1.9 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.9.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.1.9.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.1.9.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.1.9.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.9.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 100 mm (4 inches) and larger when the temperature of the medium is 16 degrees C or higher. Type 40 shields shall be used on all piping less than 100 mm (4 inches) and all piping 100 mm (4 inches) and larger carrying medium less than 16 degrees C . A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 50 mm (2 inches) and larger.

3.1.9.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 23 kg shall have the excess hanger loads suspended from panel points.

3.1.9.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 4.5 m , not more than 2.4 m from end of risers, and at vent terminations.

3.1.9.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.9.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping under 100 mm (4 inches), a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.9.10 NOT USED

3.1.9.11 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.9.12 NOT USED

3.1.9.13 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL.

3.1.10 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 1.5 m on each side of each expansion joint, and in lines 100 mm (4 inches) or smaller not more than 600 mm on each side of the joint.

3.1.11 Pipe Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Detailed drawings of pipe anchors shall be submitted for approval before installation.

3.1.12 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet

metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 1.0 mm (20 gauge). Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M, Standard weight. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 13 mm depth. Sleeves shall not be installed in structural members.

3.1.12.1 NOT USED

3.1.12.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 6.35 mm all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07900 JOINT SEALING.

3.1.12.3 NOT USED

3.1.12.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07840 FIRESTOPPING.

3.1.12.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.13 Pumps

Support, anchor, and guide so that no strains are imposed on pump by weight or thermal movement of piping. Air vents on pump casings shall be provided. Drain outlets on pump bases shall be piped to the nearest floor or other acceptable drains, with necessary clean-out tees.

3.1.14 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METALS.

3.1.15 Field Applied Insulation

Field installed insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.16 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTING, GENERAL.

3.1.16.1 Color Coding

Color coding for piping identification is specified in Section 09900 PAINTING, GENERAL.

3.2 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.3 FIELD TESTS

Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.3.1 Hydrostatic Tests

Following the cleaning procedures defined above, all chilled and condenser water piping systems shall be hydrostatically tested as defined herein. Unless otherwise agreed by the Contracting Officer, water (or glycol solution) shall be the test medium.

3.3.1.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the test pressure shall be properly isolated.

3.3.1.2 Tests

Piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Test pressure shall be monitored by a calibrated, test pressure gauge. Leaks shall be repaired and piping retested until test is successful. No loss of

pressure shall be allowed. Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before concealing.

3.3.2 Backflow Prevention Assemblies Tests

Backflow prevention assemblies shall be tested in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

3.4 NOT USED

3.5 ONE-YEAR INSPECTION

At the conclusion of the one year period, each connecting liquid chiller condenser shall be inspected for problems due to corrosion, scale, and biological growth. If the equipment is found not to conform to the manufacturers recommended conditions, and the water treatment company recommendations have been followed; the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

-- End of Section --

SECTION 15182A

REFRIGERANT PIPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 710	(1995) Liquid-Line Driers
ARI 720	(1997) Refrigerant Access Valves and Hose Connectors
ARI 750	(1994) Thermostatic Refrigerant Expansion Valves
ARI 760	(1994) Solenoid Valves for Use With Volatile Refrigerants

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 280	(1999) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 32	(1996) Solder Metal
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM D 520	(2000) Zinc Dust Pigment
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE 17	(1998) Method of Testing for Capacity Rating of Thermostatic Refrigerant Expansion Valves

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS Brazing Hdbk	(1991) Brazing Handbook
AWS Z49.1	(1999) Safety in Welding and Cutting

ASME INTERNATIONAL (ASME)

ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B31.1	(1998) Power Piping
ASME B31.5	(1992; B31.5a1994) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Refrigerant Piping System; G, RE

Drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Piping layouts which identify all valves and fittings.

b. Plans and elevations which identify clearances required for maintenance and operation.

SD-03 Product Data

Refrigerant Piping System; G, RE

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be provided for the following components as a minimum:

a. Piping and Fittings

b. Valves

c. Piping Accessories

d Pipe Hangers, Inserts, and Supports

Spare Parts

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Qualifications

6 copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations.

Refrigerant Piping Tests

A schedule, at least 2 weeks prior to the start of related testing, for each test. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

SD-06 Test Reports

Refrigerant Piping Tests

Six copies of the report shall be provided in bound 216 x 279 mm (8 1/2 x 11 inch) booklets. Reports shall document all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

SD-07 Certificates

Service Organization

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Operation Manuals

Six complete copies of an operation manual in bound 216 x 279 (81/2 x 11 inch) booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service

manual, and a brief description of all equipment and their basic operating features.

Maintenance Manuals

Six complete copies of maintenance manual in bound 216 x 279 (81/2 x 11 inch) booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping layouts and simplified wiring and control diagrams of the system as installed.

1.3 QUALIFICATIONS

Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply the personally assigned symbol near each weld made, as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

1.4 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

1.5 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.6.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The

Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 ELECTRICAL WORK

Electrical equipment and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Field wiring shall be in accordance with manufacturer's instructions. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.3 REFRIGERANT PIPING SYSTEM

Refrigerant piping, valves, fittings, and accessories shall be in accordance with ASHRAE 15 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories shall be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service shall be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant.

2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

2.4.1 NOT USED

2.4.2 NOT USED

2.4.3 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing

shall not be used in sizes larger than 35 mm (1-3/8 inches) . Joints shall be brazed except that joints on lines 22 mm (7/8 inch) and smaller may be flared. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M . Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

2.4.4 Solder

Solder shall conform to ASTM B 32, grade Sb5, tin-antimony alloy for service pressures up to 1034 kPa . Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

2.4.5 Brazing Filler Metal

Filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.5 VALVES

Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass, bronze, steel, or ductile iron construction. Valves 25 mm and smaller shall have brazed or socket welded connections. Valves larger than 25 mm shall have tongue-and-groove flanged or butt welded end connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.5.1 Refrigerant Stop Valves

Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a handwheel or wrench operator and a seal cap. Valve shall be the straight or angle pattern design as indicated.

2.5.2 Check Valves

Valve shall be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve shall be provide with resilient seat.

2.5.3 Liquid Solenoid Valves

Valves shall comply with ARI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 2760 kPa (400 psi) and a maximum operating pressure differential of at least 1375 kPa (200 psi) at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

2.5.4 Expansion Valves

Valve shall conform to ARI 750 and ASHRAE 17. Valve shall be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 1 degrees C (2 degrees F) of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

2.5.5 Safety Relief Valves

Valve shall be the two-way type, unless indicated otherwise. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

2.5.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 1 degrees C change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

2.5.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with ARI 720.

2.6 PIPING ACCESSORIES

2.6.1 Filter Driers

Driers shall conform to ARI 710. Sizes 15 mm (5/8 inch) and larger shall be the full flow, replaceable core type. Sizes 15 mm (1/2 inch) and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 10.3 MPa (1.500 psi) .

2.6.2 Sight Glass and Liquid Level Indicator

2.6.2.1 Assembly and Components

Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

2.6.2.2 Gauge Glass

Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

2.6.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens

Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighted viewing shall be provided.

2.6.2.4 Moisture Indicator

Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.6.3 Vibration Dampeners

Dampeners shall be of the all-metallic bellows and woven-wire type.

2.6.4 Flexible Pipe Connectors

Connector shall be a composite of interior corrugated phosphor bronze or

Type 300 Series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at 150 degrees C (300 degrees F) . Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

2.6.5 Strainers

Strainers used in refrigerant service shall have brass or cast iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

2.6.6 Pressure and Vacuum Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 85 mm in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.6.7 Temperature Gauges

Temperature gauges shall be the industrial duty type and be provided for the required temperature range. Gauges shall have Celsius scale in 1 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 1.5 m of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 1.5 to 2.1 m above the finished floor. Remote element type temperature gauges shall be provided in thermal wells located 2.1 m above the finished floor.

2.6.7.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 229 mm (9 inches) long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.6.7.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 89 mm (3-1/2 inches), stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

2.6.7.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 89 mm (3-1/2 inches), stainless steel or cast aluminum with clear acrylic

lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.6.7.4 Thermal Well

Thermal well shall be identical size, 15 or 20 mm (1/2 or 3/4 inch) NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 15 mm (1/2 inch) NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 25 mm .

2.6.8 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58 and MSS SP-69.

2.6.9 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.7 FABRICATION

2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 3 mm on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.7.2 Factory Applied Insulation

Refrigerant suction lines between the cooler and each compressor shall be insulated with not less than 19 mm (3/4 inch) thick unicellular plastic foam. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be

tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

2.8 SUPPLEMENTAL COMPONENTS/SERVICES

2.8.1 Field Applied Insulation

Field applied insulation shall be provided and installed in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.1.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.1.2 Functional Requirements

Piping shall be installed 4 mm per m of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

3.1.3 Fittings and End Connections

3.1.3.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show

after the joint is made.

3.1.3.2 Brazed Connections

Brazing shall be performed in accordance with AWS Brazing Hdbk, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.3.3 NOT USED

3.1.3.4 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.3.5 Flanged Connections

When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, chillers, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for use with the refrigerants to be handled.

3.1.4 Valves

3.1.4.1 General

Refrigerant stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Stop valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensible gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

3.1.4.2 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 54 mm (2-1/8 inches) in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 54 mm (2-1/8 inches). The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.1.4.3 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 34 mm (1-3/8 inch) diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto.

3.1.5 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and shall be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

3.1.6 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices. Strainers may be an integral part of an expansion valve.

3.1.7 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed. Dryers shall be installed such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

3.1.8 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of all filter dryers and where indicated. Site glasses shall be full line size.

3.1.9 Discharge Line Oil Separator

Discharge line oil separator shall be provided in the discharge line from each compressor. Oil return line shall be connected to the compressor as recommended by the compressor manufacturer.

3.1.10 NOT USED

3.1.11 Flexible Pipe Connectors

Connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

3.1.12 Temperature Gauges

Temperature gauges shall be located specifically on, but not limited to the following: the sensing element of each automatic temperature control device where a thermometer is not an integral part thereof, the liquid line leaving a receiver and the suction line at each evaporator or liquid cooler. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 25 mm .

3.1.13 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.13.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.1.13.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.1.13.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.1.13.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.13.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 100 mm (4 inches) and larger when the temperature of the medium is 16 degrees C or higher. Type 40 shields shall be used on all piping less than 100 mm (4 inches) and all piping 100 mm (4 inches) and larger carrying medium less than 16 degrees C . A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 50 mm (2 inches) and larger.

3.1.13.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 23 kg shall have the excess hanger loads suspended from panel points.

3.1.13.7 NOT USED

3.1.13.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.13.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping under 100 mm (4 inches), a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.13.10 NOT USED

3.1.13.11 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.13.12 NOT USED

3.1.13.13 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural

steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05120A STRUCTURAL STEEL.

3.1.14 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 1.5 m on each side of each expansion joint, and in lines 100 mm (4 inches) or smaller not more than 600 mm on each side of the joint.

3.1.15 NOT USED

3.1.16 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 1.0 mm (20 gauge) . Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M, Standard weight. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 13 mm depth. Sleeves shall not be installed in structural members.

3.1.16.1 NOT USED

3.1.16.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 6.35 mm all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07900A JOINT SEALING.

3.1.16.3 NOT USED

3.1.16.4 NOT USED

3.1.16.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.17 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of

sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METAL.

3.1.18 Field Applied Insulation

Field installed insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.19 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTING, GENERAL.

3.1.19.1 Color Coding

Color coding for piping identification is specified in Section 09900 PAINTING, GENERAL.

3.2 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter shall be considered contaminated systems. Restoring contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, shall be performed using currently approved refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Government as determined by the Contracting Officer. Water shall not be used in any procedure or test.

3.3 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, the entire refrigeration system shall be subjected to pneumatic, evacuation, and startup tests as described herein. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.3.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief

valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

3.3.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 55 degrees C (minus 70 degree F) dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 69 kPa (10 psi) with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 with a maximum test pressure 25 percent greater. Pressure above 690 KPa (100 psig) shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 2 kPa (0.3 psi) will be allowed for each degree C (F) change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

3.3.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 2 degrees C . No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

3.3.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to

normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

3.3.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.3.6 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 85 g (3 ounces) of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

-- End of Section --

SECTION 15190A

GAS PIPING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA Manual	(1994; Addenda/Correction Jan 1996) A.G.A. Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.45	(1995) Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
ANSI Z21.69	(1999) Connectors for Movable Gas Appliances

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(1994; Supple 1 Jun 1996; Supple 2 Dec 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.33	(1990) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (Sizes 1/2 through 2
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24

ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping
ASME B31.2	(1968) Fuel Gas Piping
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(1994) Commercial Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(1999) Gas and Oil Equipment Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Welding

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and

welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

1.2.2 NOT USED

1.2.3 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Manufacturer's descriptive data and installation instructions shall be submitted for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Valves, flanges and fittings shall be marked in accordance with MSS SP-25.

1.2.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System; G, RE.

Drawings showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of connectors and supports.

SD-03 Product Data

Qualifications

Qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-06 Test Reports

Testing
Pressure Tests
Pressure Tests for Liquified Petroleum Gas
Test With Gas

Test reports in booklet form tabulating test and measurements

performed. The reports shall be dated after award of this contract, shall state the contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Steel Pipe, Joints, and Fittings

Steel pipe shall conform to ASME B36.10M. Malleable-iron threaded fittings shall conform to ASME B16.3. Steel pipe flanges and flanged fittings including bolts, nuts, and bolt pattern shall be in accordance with ASME B16.5. Wrought steel buttwelding fittings shall conform to ASME B16.9. Socket welding and threaded forged steel fittings shall conform to ASME B16.11.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 NOT USED

2.1.5 NOT USED

2.1.6 NOT USED

2.1.7 Sealants for Steel Pipe Threaded Joints

Joint sealing compound shall be listed in UL Gas&Oil Dir, Class 20 or less. Tetrafluoroethylene tape shall conform to UL Gas&Oil Dir.

2.1.8 Identification

Pipe flow markings and metal tags shall be provided as required.

2.1.9 Flange Gaskets

Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1.6 mm (1/16 inch) thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 316 degrees C (600 degrees F) service. NBR binder shall be used for hydrocarbon service.

2.1.10 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.11 Escutcheons

Escutcheons shall be chromium-plated steel or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set

screw.

2.1.12 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing metallic and thermoplastic or fiberglass pipe. Approved transition fittings are those that conform to AGA Manual requirements for transitions fittings.

2.1.13 Insulating Pipe Joints

2.1.13.1 Insulating Joint Material

Insulating joint material shall be provided between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.1.13.2 Threaded Pipe Joints

Joints for threaded pipe shall be steel body nut type dielectric unions with insulating gaskets.

2.1.13.3 Flanged Pipe Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.1.14 Flexible Connectors

Flexible connectors for connecting gas utilization equipment to building gas piping shall conform to ANSI Z21.45. Flexible connectors for movable food service equipment shall conform to ANSI Z21.69.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Valves 50 mm and Smaller

Valves 50 mm and smaller shall conform to ASME B16.33 and shall be of materials and manufacture compatible with system materials used.

2.2.2 Valves 65 mm and Larger

Valves 65 mm and larger shall be carbon steel conforming to API Spec 6D, Class 150.

2.3 PIPE HANGERS AND SUPPORTS

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

2.4 METERS, REGULATORS AND SHUTOFF VALVES

Meters, regulators and shutoff valves shall be provided by Virginia Natural Gas.

2.5 GAUGES

Provide gauges as described in 15181R. Calibrate PA and inches WC. Provide isolating valve. All components shall be approved for gas system use.

PART 3 EXECUTION

3.1 NOT USED

3.2 GAS PIPING SYSTEM

Gas piping system shall be from the point of delivery, defined as the outlet of the service regulator to the connections to each gas utilization device.

3.2.1 Protection of Materials and Components

Pipe and tube openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. At the completion of all work, the entire system shall be thoroughly cleaned.

3.2.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Defects in piping, tubing or fittings shall not be repaired. When defective piping, tubing, or fittings are located in a system, the defective material shall be replaced.

3.3 PROTECTIVE COVERING

3.3.1 NOT USED

3.3.2 Aboveground Metallic Piping Systems

3.3.2.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing or commercial sand blasted conforming to SSPC SP 6 and primed with ferrous metal primer or vinyl type wash coat. Primed surface shall be finished with two coats of exterior oil paint or vinyl paint.

3.4 INSTALLATION

Installation of the gas system shall be in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, AGA

Manual, and as indicated. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 150 mm and larger, an approved gas cutting and beveling machine may be used. Cutting of thermoplastic and fiberglass pipe shall be in accordance with AGA Manual.

3.4.1 Metallic Piping Installation

Underground piping shall be buried a minimum of 450 mm below grade. Changes in direction of piping shall be made with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Aluminum alloy pipe shall not be used in exterior locations or underground.

3.4.2 NOT USED

3.4.3 NOT USED

3.4.4 NOT USED

3.4.5 NOT USED

3.4.6 Concealed Piping in Buildings

When installing piping which is to be concealed, unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combinations of fittings shall not be used.

3.4.6.1 Piping in Partitions

Concealed piping shall be located in hollow rather than solid partitions. Tubing passing through walls or partitions shall be protected against physical damage.

3.4.7 Aboveground Piping

Aboveground piping shall be run as straight as practicable along the alignment indicated and with a minimum of joints. Piping shall be separately supported. Exposed horizontal piping shall not be installed farther than 150 mm from nearest parallel wall in laundry areas where clothes hanging could be attempted.

3.4.8 Final Gas Connections

Unless otherwise specified, final connections shall be made with rigid metallic pipe and fittings. Final connections to kitchen ranges shall be made using flexible connectors not less than 1.02 m long. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.4.9 Gauge

Provide gauge in each mechanical room gas pipe main, at the most remote end of the main, and elsewhere as shown.

3.5 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.5.1 Threaded Metallic Joints

Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 40 mm in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 50 mm in diameter may be made with approved joint sealing compound. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

3.5.2 Welded Metallic Joints

Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.6 PIPE SLEEVES

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. All rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor or roof, and shall be cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Sleeves in mechanical room floors above grade shall extend at least 100 mm above finish floor. Unless otherwise indicated, sleeves shall be large enough to provide a minimum clearance of 6.4 mm all around the pipe. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, the annular space between the pipe and sleeve shall be sealed with firestopping material and sealant that meet the requirement of Section 07840A FIRESTOPPING.

3.7 PIPES PENETRATING WATERPROOFING MEMBRANES

Pipes penetrating waterproofing membranes shall be installed as specified in Section 15400A PLUMBING, GENERAL PURPOSE.

3.8 FIRE SEAL

Penetrations of fire rated partitions, walls and floors shall be in accordance with Section 07840A FIRESTOPPING.

3.9 ESCUTCHEONS

Escutcheons shall be provided for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.10 SPECIAL REQUIREMENTS

Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall conform to the requirements of NFPA 54.

3.11 BUILDING STRUCTURE

Building structure shall not be weakened by the installation of any gas piping. Beams or joists shall not be cut or notched.

3.12 PIPING SYSTEM SUPPORTS

Gas piping systems in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Gas piping system shall not be supported by other piping. Spacing of supports in gas piping and tubing installations shall conform to the requirements of NFPA 54. The selection and application of supports in gas piping and tubing installations shall conform to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. The clips or clamps shall be rigidly connected to the common base member. A clearance of 3.2 mm shall be provided between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.13 ELECTRICAL BONDING AND GROUNDING

The gas piping system within the building shall be electrically continuous and bonded to a grounding electrode as required by NFPA 70. Conventional flange joints allow sufficient current flow to satisfy this requirement.

3.14 SHUTOFF VALVE

Main gas shutoff valve controlling the gas piping system shall be easily accessible for operation and shall be installed as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled.

3.15 NOT USED

3.16 TESTING

Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned and cleared of all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.

3.16.1 Pressure Tests

Before appliances are connected, piping systems shall be filled with air or an inert gas and shall withstand a minimum pressure of 21 kPa gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Oxygen shall not be used. Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 1 kPa. The source of pressure shall be isolated before the pressure tests are made.

3.16.2 Pressure Tests for Liquified Petroleum Gas

Systems shall withstand the pressure test described above. When appliances are connected to the piping system, fuel gas shall be used for testing and appliances shall withstand a pressure of not less than 2.5 kPa nor more than 3.5 kPa for a period of not less than 10 minutes without showing any drop in pressure. Pressure shall be measured with a water manometer or an equivalent device calibrated to be read in increments of not greater than 20 Pa. The source of pressure shall be isolated before the pressure tests are made.

3.16.3 Test With Gas

Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed. Immediately after turning on the gas, the piping system shall be checked for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. All testing shall conform to the requirements of NFPA 54. If leakage is recorded, the gas supply shall be shut off, the leak shall be repaired, and the tests repeated until all leaks have been stopped.

3.16.4 Purging

After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. LPG piping tested using fuel gas with appliances connected does not require purging. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended

in NFPA 54 are followed.

3.16.5 Labor, Materials and Equipment

All labor, materials and equipment necessary for conducting the testing and purging shall be furnished by the Contractor.

3.17 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

-- End of Section --

SECTION 15400R

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 700	(1995; Apx C) Specifications for Fluorocarbon and Other Refrigerants
ARI 1010	(1994) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1	(1993; Z21.10.1a; Z21.10.1b; Z21.10.1c) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3	(1998) Gas Water Heaters Vol. III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous Water Heaters
ANSI Z21.22	(1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems
ANSI Z358.1	(1998) Emergency Eyewash and Shower Equipment

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 105/A 105M	(1998) Carbon Steel Forgings for Piping Applications

ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(1999a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 515/A 515M	(1989; R 1997) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(1990; R 1996) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 536	(1984; R 1999el) Ductile Iron Castings
ASTM A 733	(1999) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 888	(1998el) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 32	(1996) Solder Metal
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 152	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 152M	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar (Metric)
ASTM B 306	(1999) Copper Drainage Tube (DWV)
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM B 584	(1998a) Copper Alloy Sand Castings for General Applications
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1998) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2822	(1991; R 1997el) Asphalt Roof Cement
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E 1	(1998) ASTM Thermometers
ASTM F 409	(1999a) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 34	(1997) Number Designation and Safety Classification of Refrigerants
ASHRAE 90.1	(1989; 90.1b; 90.1c; 90.1d; 90.1e; 90.1g; 90.1i; 90.1l-1995; 90.1m-1995; 90.1n-1997) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(1991; R 1998) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1997) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME A112.19.2M	(1998) Vitreous China Plumbing Fixtures
ASME A112.19.3M	(1987; R 1996) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.21.1M	(1991; R 1998) Floor Drains

ASME A112.36.2M	(1991; R 1998) Cleanouts
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1992; Errata Jan 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.29	(1994) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1998) Power Piping
ASME B31.5	(1992; B31.5a1994) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASME CSD-1	(1998) Controls and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND SANITARY RESEARCH(ASSE)

ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1003	(1995) Water Pressure Reducing Valves for Domestic Water Supply Systems
ASSE 1005	(1986) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE 1011	(1995) Hose Connection Vacuum Breakers
ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1986) Trap Seal Primer Valves Water Supply Fed
ASSE 1020	(1998) Pressure Vacuum Breaker Assembly (Recommended for Outdoor Usage)
ASSE 1037	(1990; Rev thru Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA EWW	(1999) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1999) Hypochlorites
AWWA B301	(1992; Addenda B301a - 1999) Liquid Chlorine
AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C203	(1997; addenda C203a - 1999) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA D100	(1996) Welded Steel Tanks for Water Storage

AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(1997) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI HSN-85	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR 430	Energy Conservation Program for Consumer Products
PL 93-523	(1974; Amended 1986) Safe Drinking Water Act

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube Handbook	(1995) Copper Tube Handbook

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-01	(1993) Manual of Cross-Connection Control

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(1994) Centrifugal Pumps

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANCIAL OFFICIALS (IAPMO)

IAPMO Z124.5	(1997) Plastic Toilet (Water Closets) Seats

INTERNAL CODE COUNCIL (ICC)

CABO A117.1	(1998) Accessible and Usable Buildings and Facilities
ICC Plumbing Code	(2000) International Plumbing Code (IPC)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(1995) Class 3000 Steel Pipe Unions Socket-Welding and Threaded
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code

NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 61	(1999) Drinking Water System Components - Health Effects (Sections 1-9)

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01	(1999) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G 101	(1996) Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH 201	(1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 1508	(1997) Hose Clamps

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G, RE.

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Electrical Schematics

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

SD-03 Product Data

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing Fixture Schedule; G, RE.

Catalog cuts of specified plumbing fixtures and valves system and system location where installed.

Vibration-Absorbing Features

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and

testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where materials or equipment are specified to comply with requirements of AGA, ASME, or NSF proof of such compliance shall be included. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Plumbing System

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.6 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with ICC Plumbing Code.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade

65-45-12), Malleable Iron ASTM A 47/A 47M, Grade 32510.

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm (1/16 inch) thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

e. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.

f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.

g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

h. Solder Material: Solder metal shall conform to ASTM B 32.

i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 110 degrees C (230 degrees F).

m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

o. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Asphalt Roof Cement: ASTM D 2822.

d. Hose Clamps: SAE J 1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.

l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.

m. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm (2-1/2 inches) and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm (3 inches) and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-68, MSS SP-61
Cast-Iron Gate Valves, Flanged and	

Description	Standard
Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 NOT USED

2.3.2 Hose Bibbs

Hose bibbs with vacuum-breaker backflow preventer shall be brass with 20 mm (3/4 inch) male inlet threads, hexagon shoulder, and 20 mm (3/4 inch) hose connection. Faucet handle shall be securely attached to stem, or removable as shown.

2.3.3 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the

wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 20 mm (3/4 inch) exposed hose thread on spout and 20 mm (3/4 inch) male pipe thread on inlet.

2.3.4 NOT USED

2.3.5 NOT USED

2.3.6 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh) shall have 20 mm (3/4 inch) minimum inlets, and 20 mm (3/4 inch) outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW (200,000 Btuh) shall have 25 mm (1 inch) minimum inlets, and 25 mm (1 inch) outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.7 Thermostatic Mixing Valves

Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC Plumbing Code. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap.

Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 82 degrees C (180 degrees F) water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing to the seepage pan without damaging the flashing shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.21.1M.

FD-1 = 205 mm (8") diameter, 100 mm (4") outlet, except in shower areas where it is 50 mm (2").

FD-2 = 225 (9") square hinged with 100 mm (4") outlet.

2.6.2 NOT USED

2.6.3 Floor Sinks

Floor sinks shall be square with 300 mm (12 inch) nominal overall width or diameter and 250 mm (10 inch) nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in car wash area and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.4 NOT USED

2.6.5 Trench Drains (TD-1)

Trench drain shall be 305 mm wide x 610 mm long, top drain with standard manufacturers coating. Drain shall be cast iron body with bottom outlet. Both 305 mm long outlet module and 305 mm long extension module shall be complete with integral seepage pan and heavy-duty loose slotted grate.

2.6.6 Sight Drains (FD-3)

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar	0.023 square meters (36 square inches)
Height of funnel	95 mm (3-3/4 inches)
Diameter of lower portion of funnel	50 mm (2 inches)
Diameter of upper portion of funnel	100 mm (4 inches)

2.7 NOT USED

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.813 mm (0.032 inch) thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in

manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm (2 inches). The interior diameter shall be not more than 3.2 mm (1/8 inch) over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.9 GREASE INTERCEPTOR

Grease interceptor of the size indicated shall be of reinforced concrete, or equivalent capacity commercially available steel grease interceptor with removable three-section, 9.5 mm (3/8 inch) checker-plate cover, and shall be installed outside the building. Steel grease interceptor shall be installed in a concrete pit and shall be epoxy-coated to resist corrosion as recommended by the manufacturer. Interceptors shall be tested and rated in accordance with PDI G 101. Concrete shall have 21 MPa minimum compressive strength at 28 days.

2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 32 to 71 degrees C (90 to 160 degrees F). Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 49 to 82 degrees C (120 to 180 degrees F). Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 2000 liters storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.10.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.10.1.1 NOT USED

2.10.1.2 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 22 KW

(75,000 BTU per hour) or less or ANSI Z21.10.3 for heaters with input greater than 22 KW (75,000 BTU per hour).

2.11 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 175 mm (7 inch) scale. Thermometer shall have a separable socket suitable for a 20 mm (3/4 inch) tapped opening. Tanks shall be equipped with a pressure gauge 155 mm (6 inch) minimum diameter face. Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.12 PUMPS

2.12.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 75 and 150 mm above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 1 enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.12.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient wattage (horsepower) for the service required. Pump shall conform to HI 1.1-1.5. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with

"START-STOP" switch in cover. Pump motors smaller than 746 W (Fractional horsepower pump motors) shall have integral thermal overload protection in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Guards shall shield exposed moving parts.

2.13 NOT USED

2.14 COMPRESSED AIR SYSTEM

2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 1 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensate before the air enters the receiver. Aftercoolers shall be either air- or water-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.14.2 NOT USED

2.14.3 Air Receivers

Receivers shall be designed for 1.38 MPa (200 psi) working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPV VIII Div 1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.14.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall

withstand a maximum 862 kPa (125 psi), capacity as indicated.

2.14.5 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 862 kPa (125 psi) and a maximum temperature of 93 degrees C (200 degrees F). Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 kPa to 862 kPa (0 to 125 psi). Regulator shall be sized as indicated.

2.14.5.1 Pressure Gauge

Provide a pressure gauge on lowside and highside of each pressure regulator. Gauge shall have pressure range to match regulator, and face shall show both kPa and psig. Gauges shall be as specified in Specification Section 15569R.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 150 mm above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable

isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 12 mm between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 20 mm (3/4 inch) hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 20 mm (3/4 inch) brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 NOT USED

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 862 kPa (125 psig) working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with

the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm (2-1/2 inches) and smaller; flanges shall be used on pipe sizes 80 mm (3 inches) and larger.

3.1.3.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.6 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections.

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube Handbook with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 50 mm (2 inches) and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube Handbook.

c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate

tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC Plumbing Code using B-cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

3.1.5.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA C105. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs

shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and vent pipe passing through concrete slab on grade. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm (1/4 inch) clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900 JOINT SEALING. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 12 mm (1/2 inch) from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07840 FIRESTOPPING.

3.1.6.2 Flashing Requirements

Pipes passing through roof shall be installed through a 4.9 kg per square meter (16 ounce) copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the

metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm (10 inches) in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 NOT USED

3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 150 mm (6 inches) in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, a groove 6 to 13 mm wide by 6 to 10 mm deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING.

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 NOT USED

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 100 mm (4 inches).

(2) Be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 128 kg per cubic meter (8 pcf) or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 49 degrees C for PVC and 82 degrees C for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m nor more than 2 m from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 100 mm (4 inches) a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 100 mm (4 inches) and larger carrying medium less that 15 degrees C a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm (4 inches) will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be

flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm (4 inches). Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 150 mm above the top of the tank or water heater.

3.2.2 Installation of Gas-Fired Water Heater

Installation shall conform to NFPA 54. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 600 mm just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 NOT USED

3.2.4 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 600 mm before turning in an upward direction.

3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 1 m above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 760 mm above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure. Bumpers for water closet seats shall be installed on the flushometer stop and flushometer spud.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1020 mm above floor. Wall-hung service sinks shall be mounted with rim

700 mm above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.5.3 NOT USED

3.3.5.4 NOT USED

3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC Plumbing Code at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water

to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm above the flood rim of the funnel to provide an acceptable air gap.

3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

3.4.2 Foundation-Mounted Compressors

Foundation shall be as recommended by the compressor manufacturer, except the foundation shall weigh not less than three times the weight of the moving parts. Compressors shall be mounted to resist seismic loads as specified in Section 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.5 NOT USED

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm (1-3/8 inch) minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 12 mm in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 1 m width, 750 mm height, and 12 mm thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm (1/16 inch) transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 20 mm (3/4 inch) in diameter and the related lettering in 12 mm high capital letters. The color code board shall be mounted and located in the mechanical or equipment room.

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC Plumbing Code.

a. Drainage and Vent Systems Tests.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 NOT USED

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 1.03 MPa and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a

water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 1.2 meters per second (4 fps) through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The

Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.9.6 Flushing of Potable Water System

As an option to the system flushing specified above, the potable water system system shall be flushed and conditioned until the residual level of lead is less than that specified by the base industrial hygienist. The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.10 PLUMBING FIXTURE SCHEDULE

WC-1 WATER CLOSET:

Acceptable Water Closet Manufacturers and Models:
American Standard, Model 2257.103
Eljer, Model 111.2105
Crane, Model 3446
Kohler, Model K-4430-ET
Or an approved equal in accordance with section 00700, Materials and Workmanship.

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, wall mounted. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - IAPMO Z124.5, Type A, white plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 6 liters per flush.

WC-2 WATER CLOSET HANDICAPPED:

Height of top rim of bowl shall be in accordance with CABO A117.1; other features are the same as P-1.

WC-3 WATER CLOSET:

Acceptable Water Closet Manufacturers and Models:
American Standard, Model 2305.100
Or an approved equal in accordance with section 00700, Materials and Workmanship.

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor mounted. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - IAPMO Z124.5, Type A, white plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 6 liters per flush.

UR-1 URINAL:

Acceptable Urinal Manufacturers and Models:
American Standard, Model 6561.017
Eljer, Model 161-1090
Crane, Model 7160
Kohler Co., Model K-4989-T

Or an approved equal in accordance with section 00700, Materials and Workmanship.

Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet.

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 3.8 liters per flush.

UR-2 URINAL HANDICAPPED:

Height of top rim shall be in accordance with ANSI A117.1; other features are same as UR-1.

L-1, L-2 LAVATORY:

Acceptable Lavatory Manufacturers and Models:
American Standard, 0476.028 (self-rimming)
Or an approved equal in accordance with section 00700, Materials and Workmanship.

Manufacturer's standard sink depth, vitreous china ASME A112.19.2M, front overflow drop-in self-rimming oval.

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be single control, mixing type for mounting on 4" centers. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 1 liter per cycle at a flowing water pressure of 549 kPa if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second at a flowing pressure of 549 kPa.

Handles - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Strainer shall be copper alloy or stainless steel. See paragraph FIXTURES for optional plastic accessories.

Drain - Strainer shall be copper alloy or stainless steel.

HS-1 HAND SINK:

Acceptable Lavatory Manufacturers and Models:
American Standard, 0356.041 (Wall Hung)
Or an approved equal in accordance with section 00700, Materials and Workmanship.

Manufacturer's standard sink depth, vitreous china ASME A112.19.2M, front overflow, ledge back, wall hung.

Faucet - Faucet shall meet the requirements of NSF 61, Section 9. Faucet

shall have dual foot pedal control, mixing type for floor mounting. Faucet shall be gooseneck type. Faucet shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and pedals shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. The flow shall be limited to 0.16 liters per second at a flowing pressure of 549 kPa.

Pedals - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Strainer shall be copper alloy or stainless steel. See paragraph FIXTURES for optional plastic accessories.

Drain - Strainer shall be copper alloy or stainless steel.

S-1 SINK:

Acceptable Sink Manufacturers and Models
Double Compartment, Dayton Model DSE-23322
Or an approved equal in accordance with section 00700, Materials and Workmanship.

Ledge back with holes for faucet and spout double bowl 812.8 x 533.4 mm (32 x 21 inches) stainless steel ASME A112.19.3M.

Faucet and Spout - Faucets shall meet the requirements of NSF 61, Section 9. Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 1 liter per cycle at a flowing water pressure of 549 kPa if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second at a flowing water pressure of 549 kPa.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

S-2 (Same as S-1, with darkroom silver trap)

MB-1 MOP SERVICE BASIN:

Terrazo with S/S edgeguard 2 sides, ASME A112.19.3M corner, floor mounted 711.2 mm (28 inches) square, 171.5 mm (6-3/4 inches) deep.

Faucet and Spout - Cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be four arm type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 7.5 cm diameter.

SH-1 Wall Mounted Shower:

Shower head shall be adjustable spray, stainless steel or chromium plated brass with ball joint. Handles shall be manufacturer's option. Control valves shall include wall mount, copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be pressure balancing type. Shower head shall be vandalproof with integral back.

SH-2 SHOWER HEAD SYSTEM, HANDICAPPED

Shower system with wall supply complete with pressure balance valve, a wall supply with 15 mm NPT female inlet and 15 m male outlet, a 1525 mm hose, a fixed personnel shower and a 640 mm slide bar. ADA compliant.

Valve shall be cast brass body with washerless ceramic disc valve cartridge with hot limit safety stop. Pressure balance valve shall maintain a constant output temperature in response to changes in hot and cold water supply pressures.

Fixed handshower with 0.16 liters per second, non-removable, tamperproof flow restrictor when tested in accordance with ASME A112.18.1M.

Slide bar with adjustable shower holder which can be set at any height or position along the bar and angle up to 45 degrees.

EMERGENCY SHOWERS

Head for Emergency and Emergency Eye and Face Wash. Shower control shall be 25 mm (1 inch) or 40 mm (1-1/2 inch) stay-open type control valve. Unit shall be corrosion-resisting steel and shall be pedestal mounted. Emergency showers shall comply with ANSI Z358.1.

EWC-1 & 2 WATER COOLER DRINKING FOUNTAINS:

Acceptable Water Cooler Drinking Fountains Manufacturers and Models:
Haws, Model HWCA8F
Oasis PLF8SKPE
Sun Roc, Model HCWC-8F
Elkay, Model EHFA8
Halsey Taylor, Model WC8AF-Q
Or an approved equal in accordance with section 00700, Materials and Workmanship.

Drinking fountains shall meet the requirements of NSF 61, Section 9. Water cooler drinking fountains shall: be self contained, conform to ARI 1010, use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05, have a capacity to deliver 30.2 liters per hour (8 gph) of water at 10 degrees C (50 degrees F) with an inlet water temperature of 27 degrees C (80 degrees F) while residing in a room environment of 32 degrees C (90 degrees F), and have self-closing valves. Self-closing valves shall have automatic

stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 100 mm (4 inches) high so as to allow the insertion of a cup or glass under the flow of water.

Surface Wall-Mounted - Surface wall-mounted units shall be 336.6 mm (13-1/4 inches) wide, 330.2 mm (13 inches) deep, and have a back height of 152.4 to 203.2 mm (6 to 8 inches). The bowl shall be made of stainless steel. The unit shall have concealed fasteners and be for interior installation.

Handicapped - Handicapped units shall be surface wall-mounted. The dimensions shall be 381.0 mm (15 inches) wide, 508.0 mm (20 inches) deep, with a back height of 152.4 to 203.2 mm (6 to 8 inches). The unit shall clear the floor or ground by at least 230 mm (8 inches). A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 685 mm (27 inches) and between the front edge of the bowl and the body of the unit of at least 200 mm (8 inches). A 200 mm (8 inch) wide clear space shall exist on both sides of the unit. The spout height shall be no more than 915 mm (36 inches) above the floor or ground to the outlet. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl shall be 165.1 mm (6-1/2 inches) high, made of stainless steel and be for interior installation. Provide accessory apron to meet ADA Guidelines.

WF-1 WASH FOUNTAIN:

Semicircular - 3 station 1.9837 mm (14 gauge), terrazo bowl, stainless steel foot controls flow rate .19LPS bowl. Provide spray heads with stainless steel support tube and bowl basket; spud and locknut and beehive strainer, sprayhead supply pipe, thermostatic mixing valve, volume control valve and combination stop strainer and check valves.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = o (trace is permitted).

SL = Standby loss in W/0.093 sq. m. based on 27 degrees C delta T, or in percent per hour based on nominal 38 degrees C delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

3.12.1 Storage Water Heaters

3.12.1.1 NOT USED

3.12.1.2 Gas

a. Storage capacity of 379 liters or less, and input rating of 21980 W or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.

b. Storage capacity of more than 379 liters - or input rating more than 21980 W: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per ANSI Z21.10.3.

3.13 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE				
Item #	Pipe and Fitting Materials	A	B	C	D	
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X	X	X	
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X	
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M	X	X		X	
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5	X	X		X	
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	
8	Wrought copper grooved joint pressure pressure fittings for non-ferrous pipe ASTM B 75M C12200, ASTM B 152, ASTM B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X			
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	
10	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	
11	Cast bronze threaded fittings,				X	X

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE				
Item #	Pipe and Fitting Materials	A	B	C	D	
	ASME B16.15					
12	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X
13	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X
14	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
* - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE		
Item No.	Pipe and Fitting Materials	A	B	C
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47/A 47M, non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M,	X	X	X
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M, for use with Item 2	X	X	X
4	Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B	X	X	X
	b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B			X
5	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**
6	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 5	X	X	X
7	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2	X	X	X
8	Fittings: Brass or bronze; ASME B16.15 ASME B16.18, and ASTM B 828	X	X	
9	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE		
Item No.	Pipe and Fitting Materials	A	B	C
10	Malleable-iron threaded pipe unions ASME B16.39	X	X	
11	Nipples, pipe threaded ASTM A 733	X	X	X

A - Cold Water Aboveground
B - Hot Water 82 degree C Maximum Aboveground
C - Compressed Air Lubricated
Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
**** - In or under slab floors only brazed joints

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Gas	380 max.	22 kW max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	380 min. OR	22 kW min.	ANSI Z21.10.3	ET= 77 percent; SL = 1.3+38/V max.

-- End of Section --

SECTION 15565A

HEATING SYSTEM; GAS-FIRED HEATERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.66	(1996) Automatic Vent Damper Devices for Use with Gas-Fired Appliances

INTERNATIONAL APPROVAL SERVICES (IAS)

IAS Directory	(1998) IAS Directory of AGA & CGA Certified Appliances and Accessories

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2000) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 54	(1999) National Fuel Gas Code

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(1999) Gas and Oil Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heating System
Installation

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Detail drawings for space heating equipment, controls, associated equipment, and for piping and wiring. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Heating System; G, RE

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only. When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

INDIRECT FIRED MAKE-UP AIR UNIT, Reznor, Model SCE
INDIRECT FIRED MAKE-UP AIR UNIT, Manuf. Prod. submitted as an "or equal"; G, RE

Spare parts data for each different item of materials and equipment specified, after approval of the detail drawings, and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-06 Test Reports

Testing, Adjusting, and Balancing

Test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Instructions

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features. Six complete copies of maintenance instructions listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The instructions shall include simplified piping, wiring, and control diagrams for the system as installed.

1.3 GENERAL REQUIREMENTS

1.3.1 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.

1.3.2 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.3.3 Verification of Dimensions

The Contractor shall become thoroughly familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing of the products. Equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

2.2 ELECTRICAL WORK

Electrical motor driven equipment shall be provided complete with motors, motor starters, and controls. Motors shall conform to NEMA MG 1. Electrical equipment and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Electrical characteristics shall be as specified or indicated. Unless otherwise indicated motors of 745.7 W (1 Hp) and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.3 HEATERS

Heaters shall be equipped for and adjusted to burn natural gas. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heaters shall have an intermittent or interrupted electrically ignited pilot or a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment.

2.3.1 Indirect Fired Make-Up Air Heaters

Unit shall be an indoor packaged, 100% outside air makeup air unit, with power-vented sealed combustion. Unit shall be equipped for use with natural gas. Unit shall contain a type 409 stainless steel heat exchanger, die-formed burners of type 409 stainless steel and a stainless steel drip pan. The furnace shall be equipped with all required safety and limit controls. Cabinet shall be insulated with horizontal supply opening and horizontal makeup air inlet with 2-position damper. Provide with centrifugal blower, open dripproof blower motor, adjustable belt drive. Filters shall be 50 mm pleated filters. Unit shall be 208 volt 3-phase and include magnetic starter and disconnect. Provide with electronic two-stage control using a ductstat with remote temperature adjustment. Provide remote control console with summer/winter/off switch. Manufacturer shall include a vertical vent terminal/combustion air assembly for the separated combustion of each furnace.

2.4 THERMOSTATS

Thermostats shall be the adjustable electric or electronic type. Control wiring required to complete the space temperature control system shall be included. Thermostats shall have a 2 degree C (3 degree F) differential and a set point range of 27 to 49 degrees C (80 to 120 degrees F). Thermostats shall be the two stage type.

2.5 VENT PIPING

Vent piping shall conform to the requirements of NFPA 54. Plastic material polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.6 NOT USED

2.7 INSULATION

Insulation for piping and equipment and application shall be in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.8 FACTORY FINISHES

Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as indicated and in accordance with the recommendations of the equipment manufacturer and the listing agency, except as otherwise specified.

3.1.1 Heating Equipment

Heaters shall be installed with clearance to combustibles complying with minimum distances as determined by IAS Directory, UL Gas&Oil Dir and as indicated on each heater approval and listing plate. Heaters shall be independently supported from the building structure as indicated and shall not rely on support from suspended ceiling systems.

3.1.2 Vents

Vent dampers, piping and structural penetrations shall be located as indicated. Vent damper installation shall conform to ANSI Z21.66. Vent pipes, where not connected to a masonry chimney conforming to NFPA 211, shall extend through the roof or an outside wall and shall terminate, in compliance with NFPA 54. Vents passing through waterproof membranes shall be provided with the necessary flashings to obtain waterproof installations.

3.1.3 Gas Piping

Gas piping shall be connected as indicated and shall comply with the applicable requirements at Section 15190A GAS PIPING SYSTEMS.

3.2 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.3 Training

The Contractor shall conduct a training course for the maintenance and operating staff and preventive maintenance contract personnel. The training period of 8 hours normal working time shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the approved operation and maintenance instructions as well as demonstrations of routine maintenance operations. The Contracting Officer shall be given at least two weeks advance notice of such training.

-- End of Section --

SECTION 15569R

WATER HEATING; GAS; UP TO 20 MBTUH

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13	(1991; Z21.13a; Z21.13b) Gas-Fired Low-Pressure Steam and Hot Water Boilers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	(2001) Carbon Steel Forgings for Piping Applications
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 366/A 366M	(1997el) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 515/A 515M	(1989; R 1997) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(1990; R 1996) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999el) Ductile Iron Castings

ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	(1996) Solder Metal
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(2000) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 596	(1991; R 1995) Reporting Results of Analysis of Water
ASTM F 876	(2000) Crosslinked Polyethylene (PEX) Tubing

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)

ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping
ASME B31.5	(1992; B31.5a1994) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC IV	(1998) Boiler and Pressure Vessel Code; Section IV, Heating Boilers
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME CSD-1	(1998) Controls and Safety Devices for Automatically Fired Boilers

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube Handbook	(1995) Copper Tube Handbook

HYDRONICS INSTITUTE DIVISION OF GAMA (HYI)

HYI-01	(1998) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) Radiation \$17.00;new ed ea Jan$\X
HYI-400	(1998) I=B=R Product Floor Heating

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment

(1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 8501	(1997) Single Burner Boiler Operation

UNDERWRITERS LABORATORIES (UL)

UL 1738	(1993; Rev thru Mar 1998) Venting Systems for Gas-Burning Appliances, Categories II, III and IV
UL 795	(1999) Commercial-Industrial Gas Heating Equipment
UL Gas&Oil Dir	(1999) Gas and Oil Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heating System; G, RE
Piping Installation; G, RE
Installation

Detail drawings consisting of equipment layout including installation details and electrical connection diagrams; combustion and safety control diagrams; ductwork layout showing the location of supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of guides and anchors, the load imposed on each support or anchor (not required for radiant floor tubing), and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Provide drawings that have been stamped by a professional engineer showing anchor locations.

SD-03 Product Data

<u>FINNED WATER TUBE BOILERS, Lochinvar, Inc., Model Copper-Fin II</u>

FINNED WATER TUBE BOILERS, Manufacturer Product submitted as an "or equal"; G RE.
CONDENSING BOILER, HydroTherm Corp., Model AM-100
CONDENSING BOILER,.Manuf. Prod. submitted as an "or equal"; G RE.

Manufacturer's Catalog Data; G, RE

Manufacturer's catalog data shall be included with the detail drawings for the following items:

Boilers
Fuel Burning Equipment
Combustion Control Equipment
Pumps
Fittings and Accessories
Water Treatment System

Radiant floor heating system including tubing, joints, and manifold for radiant floor heating systems.

The data shall show model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements.

Spare Parts Data

Spare parts data for each different item of material and equipment, after approval of the detail drawings and no later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

Water Treatment Plan
Boiler Water Treatment

Six complete copies of the proposed water treatment plan. The plan shall include a layout, control scheme, a list of the existing water conditions including the items listed in paragraph BOILER WATER TREATMENT, a list of all chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

Heating System Tests
Fuel System Tests

Proposed test procedures for the heating system tests and fuel system tests, at least 2 weeks prior to the start of related testing.

Welding

A copy of qualified welding procedures, at least 2 weeks prior

to the start of welding operations.

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

Qualification

A statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services of at least five projects of similar size or scope, at least 2 weeks prior to the submittal of any other item required by this section.

Field Instructions

System layout diagrams that show the layout of equipment, piping, and ductwork and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

Tests

Proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing.

SD-06 Test Reports

Heating System Tests
Fuel System Tests

Test reports for the heating system tests and the fuel system test, upon completion of testing complete with results.

Water Treatment Tests

a. The water quality test report shall identify the chemical composition of the boiler water. The report shall include a comparison of the condition of the boiler water with the manufacturer's recommended conditions. Any required corrective action shall be documented within the report.

b. A test report shall identify the condition of the boiler at the completion of 1 year of service. The report shall include a comparison of the condition of the boiler with the manufacturer's recommended operating conditions.

SD-07 Certificates

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

Continuous Emissions Monitoring

Written certification by the boiler manufacturer that each boiler furnished complies with Federal, state, and local regulations for emissions. The certification shall also include a description of applicable emission regulations. If any boiler is exempt from the emission regulations, the certification shall indicate the reason for the exemption.

SD-10 Operation and Maintenance Data

Heating System

Six complete manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

Water Treatment System

Six complete copies of operating and maintenance manuals for the step-by-step water treatment procedures, including procedures for testing the water quality.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.3.2 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

1.3.3 Nameplates

Each major component of equipment shall have the manufacturer's name,

address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each pressure vessel shall have an approved ASME stamp.

1.3.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

1.3.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

1.3.6 Welding

Boilers and piping shall be welded and brazed in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

1.4 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installing, adjusting, and testing of the equipment.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

PART 2 PRODUCTS

2.1 BOILERS

Each boiler shall have the output capacity in kilowatts (kW) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the gas burning equipment, boiler fittings and trim, automatic controls, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at

the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPVC SEC IV. Each boiler shall be of the fin-tube, sealed combustion type and designed for water service as specified herein. OMS Boiler shall be condensing type and designed for water service. The boilers capacity shall be based on the ratings shown in HYI-01 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

2.1.1 NOT USED

2.1.2 Fin-Tube Boiler

The boiler shall be a finned type of water tube boiler. Boiler shall be self-contained, packaged type, complete with all accessories, mounted on a structural steel base. Boiler shall have straight copper tubes having extruded fins spaced seven fins per inch. The tubes shall terminate into a one-piece, lined, cast iron header. There shall be access to the front header of the heat exchanger for inspection and maintenance. Boiler shall be self-contained, packaged type, complete with all accessories, mounted on a structural steel base. Burner shall be constructed of stainless steel and fire on a horizontal plane. The boiler shall have an integral combustion air blower to precisely control the fuel/air mixture. The boiler shall be constructed of heavy gauge galvanized steel jacket assembly. The exterior of the assembly shall be finished in an enamel finish. Boiler shall operate at a minimum 84 percent efficiency. The boiler shall be e certified and listed by the American Gas Association under the latest addition of the ANSI Z21.13 test standard. The boiler shall also comply with ASHRAE 90.1 Standard. 24 VAC control circuit and components shall be used. Combustion air and flue vents shall be routed horizontally out a side-wall. Manufacturer shall provide necessary accessories for this including a wall vent cap.

2.1.2.1 Acceptable Manufacturers of Watertube Boiler.

FINNED WATER TUBE BOILERS
Lochinvar, Inc., Model Copper Fin II.
Or an approved equal in accordance with section 00700, Materials and Workmanship.

2.1.3 NOT USED

2.1.4 Condensing Boiler (OMS Building)

Boiler shall be a self-contained packaged type, complete with accessories, mounted on a structural steel base or a steel base which is integral to the boiler shell. Boiler shall conform to the commercial design used by the manufacturer and shall permit free thermal expansion without placing undue

stress on any part of the boiler. Boiler which experiences the formation of condensate within the flue gas shall be specifically designed for condensing application. Boiler shall withstand the corrosive effects of condensate for each part which may be in contact with the condensate at all possible operating conditions. Boiler shall be provided with a separate air intake, exhaust, and condensate drain. Each boiler shall be designed to withstand the water temperature differentials anticipated at the required operating conditions without experiencing any damage due to thermal shock.

2.1.4.1 Acceptable Manufacturers of Condensing Boilers

HydroTherm Corp., Model AM-100.
Or an approved equal in accordance with Section 00700, Materials and Workmanship.

2.1.5 NOT USED

2.1.6 Hot Water Heating Boilers

The hot water heating boiler shall be capable of operating at the specified maximum continuous capacity without damage or deterioration to the boiler, its setting, firing equipment, or auxiliaries. The rated capacity shall be the capacity at which the boiler will operate continuously while maintaining at least the specified minimum efficiency.

2.2 FUEL BURNING EQUIPMENT

Boiler shall be designed to burn gas. Each boiler shall comply with Federal, state, and local emission regulations. As a minimum, the following emission requirements shall be met:

NOx - 9.9 kg per joule input parts per million (ppm) corrected to 3% 02 on boilers in Training Building.

2.2.1 Burners

2.2.1.1 Gas Fired Burners and Controls

Burners shall be UL approved mechanical draft burners with all air necessary for combustion supplied by a blower where the operation is coordinated with the burner. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

a. Gas-fired units with inputs greater than 1.17 MW per combustion chamber shall conform to UL 795. Gas fired units less than 3.66 MW input shall conform to ANSI Z21.13.

2.3 NOT USED

2.3.1 NOT USED

2.3.2 Electrical controls

Electrical control devices shall be rated at 24 volts and shall be connected as specified in Section 16415A ELECTRICAL WORK, INTERIOR.

2.3.3 Water Temperature Controller

The controller shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed in the boiler return piping. Fixed position (on-off) and three position (high-low-off) controller shall operate on a 5.56 degree C (10 degree F) differential over an adjustable temperature range of approximately 60 to 104.4 degrees C (140 to 220 degrees F). Controller shall be furnished with necessary equipment to automatically adjust the setting to suit the outside weather conditions. The outside air reset controller shall be operated in such a manner that the operating temperatures required by the boiler manufacturer are not compromised.

2.3.4 NOT USED

2.3.5 NOT USED

2.3.6 Boiler Combustion Controls and Positioners

a. Gas boiler units shall be provided with three position (high-low-off) combustion controls with gas pilot or spark ignition. Modulating controls shall be provided with a means for manually controlling the firing rate.

d. High-low-off controls for boilers with capacities up to 600 kW (2,000,000 Btuh) shall use a water temperature controller in a temperature well in direct contact with the water.

2.3.7 Combustion Safety Controls and Equipment

Combustion safety controls and equipment shall be UL listed, microprocessor-based distributed process controller. The system shall include mounting hardware, wiring and cables, and associated equipment. The controller shall be mounted completely wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include maintaining boiler status, starting and stopping all control functions, sequencing control functions and signaling alarm conditions. The program shall be documented and include cross references in description of coils and contacts. Microprocessor shall be able to perform self diagnostics and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be mounted on a separate, free standing panel adjacent to the boiler or for packaged boilers on the boiler supporting structure. Control systems and safety devices for automatically fired boilers shall conform to ASME CSD-1. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz and shall be connected as specified in Section 16415A ELECTRICAL WORK, INTERIOR. A 100 mm diameter alarm bell shall be provided and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock. Indicating lights shall be provided on the control panel. A red light

shall indicate flame failure, and a green light shall indicate that the main fuel valve is open. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

a. Flame failure.

b. Failure to establish pilot flame.

c. Failure to establish main flame.

d. High temperature cutoff.

2.3.7.1 NOT USED

2.3.7.2 Water Flow Interlock

Hot water boiler limit controls shall be provided to include protection for low boiler water flow and high boiler water temperature. The limit controls shall be interlocked with the combustion control system to effect boiler alarm and shutdown. The controls shall not allow boiler startup unless hot water flow is proven.

2.4 PUMPS

2.4.1 NOT USED

2.4.2 Hot Water and Boiler Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 115 degrees C temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified.

2.5 COLD WATER CONNECTIONS

Connections shall be provided which includes consecutively in line a strainer, backflow prevention device, and water pressure regulator in that order in the direction of the flow. The backflow prevention device shall be provided as indicated and in compliance with Section 15400A PLUMBING, GENERAL PURPOSE. Cold water fill connections shall be made to the water supply system as indicated. Necessary pipe, fittings, and valves required for water connections between the boiler and cold water main shall be provided as shown. The pressure regulating valve shall be of a type that will not stick or allow pressure to build up on the low side. The valve shall be set to maintain a terminal pressure of approximately,lately 35 kPa in excess of the static head on the system and shall operate within a 15 kPa tolerance regardless of cold water supply piping pressure and without

objectionable noise under any condition of operation.

2.6 UNIT HEATERS - HOT WATER AND ELECTRIC

Heaters shall be as specified below, and shall have a heating capacity not in excess of 125 percent of the capacity indicated.

2.6.1 Propeller Fan & Cabinet Heaters

Hot water and electric unit heaters shall be designed for suspension and arranged for horizontal discharge of air as indicated. Electric propeller fan heaters shall be explosion-proof, where indicated on schedule. Casings shall be not less than 0.912 mm (20 gauge) black steel and finished with lacquer or enamel. Suitable stationary deflectors shall be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Horizontal discharge type unit heaters shall have discharge or face velocities not in excess of the following:

Unit Capacity, Liters per Second	Face Velocity, Meters per Second
Up to 472 (1000)	4.06 (800)
473 (1001)	4.57 (900)
1417 (3001)	5.08 (1,000)

Electric cabinet unit heaters shall be arranged for surface wall mounting as indicated. Air inlet shall be front grill; air outlet shall be top grill. Heating elements and fans shall be housed in steel cabinets of sectionalized steel plates or reinforced with angle iron frames. Cabinets shall be constructed of not lighter than 1.27 mm black steel. Each unit heater shall be provided with a means of diffusing and distributing the air. Fans shall be mounted on a common shaft, with one fan to each air outlet. Fan shaft shall be equipped with self-aligning ball, roller, or sleeve bearings and accessible means of lubrication. All fans in any one unit heater shall be the same size.

2.6.2 NOT USED

2.6.3 Heating Elements

2.6.3.1 Hot Water Coils

For hot water unit heaters, heating coils and radiating fins shall be of suitable nonferrous alloy with threaded fittings at each end for connecting to external piping. The heating elements shall be free to expand or contract without developing leaks and shall be properly pitched for drainage. The elements shall be tested under a hydrostatic pressure of 1.38 MPa (200 psig) and a certified report of the test shall be submitted to the Contracting Officer. Coils shall be suitable for use with water up to 121 degrees C (250 degrees F).

2.6.3.2 Electric Resistance Heating Elements

For cabinet unit heaters, nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide insulating refractory and sealed in high-mass steel or corrosion resistant metallic sheath with fins no closer than 4 mm. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 288 deg. C at any point in normal operation.

For electric propeller fan unit heaters, electric coil shall be open wire; or spiral sheath or finned-tube construction with Cal-rod resistance elements in aluminum tubes. All electric heaters shall have:

1. Circuit protection: One-time fuses in terminal box for overcurrent protection and limit controls for overtemperature protection of heaters.

2. Wiring terminations: Match conductor materials and sizes indicated.

2.6.4 Motors

Hot water unit heater motors shall be provided with NEMA 250 general purpose enclosure. Cabinet unit heater fan motors shall be permanent split-capacitor, multispeed motors with integral thermal-overload protection and resilient mounts. Connect motor to chassis with plug connection. Electric explosion-proof unit heaters are Class I, Div. 2, Group D. Motors shall be UL approved and labeled for hazard class with overtemperature protection. Motors and motor controls shall otherwise be as specified in Section 16415 ELECTRICAL WORK, INTERIOR.

2.6.5 Motor Switches

Motors shall be provided with manual selection switches with "Off," and "Automatic" positions and shall be equipped with thermal overload protection. Cabinet heater shall have unit mounted fan-speed switch and thermostat.

2.6.6 Controls

Controls shall be provided as specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC.

2.7 RADIANT FLOOR HEATING SYSTEMS

The radiant floor heating system shall include all piping, manifolds, valves, pumps, expansion tank, pressure relief valves, and controls to provide a complete and operational heating system.

2.7.1 Tubing

The tubing material shall comply with ASTM F 876. The pipings shall be provided with a factory applied oxygen barrier with a diffusion rate that

does not exceed 0.1 grams per cubic meter per day. The piping shall be rated at 689 kPa and 82.5 degrees C.

2.7.2 Joints

The manifold manufacturer shall be consulted to determine the proper joint for connection of tubing to the manifold. The joints required to connect the tubing to the manifold shall be compression type fittings using crimp rings, a combination of inserts and O-rings, gripper type fittings using a retainer ring and O-rings, or as otherwise recommended by the manifold and tubing manufacturer.

2.7.3 Manifold

The design and construction of the manifold shall be compatible with the tubing manufacture's requirements. The piping manifold material shall be compatible with the piping material. The manifold shall be capable of providing the number of circuits as indicated on the drawings. The manifold shall be suitable for an operating pressure of 689 kPa and 82.5 degrees C. Balancing valves shall be provided for each circuit. Isolation valves shall be provided for each supply and return connection. Each manifold shall be provided with an air vent. the manifold shall allow for the measurement of temperature for each circuit. The manifold shall be provided with all required mounting hardware.

2.8 HEATING AND VENTILATING UNITS

Heating and ventilating units and associated equipment shall be in accordance with Section 15565A HEATING SYSTEM; GAS-FIRED HEATERS.

2.9 AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.10 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in accordance with ASME BPVC SEC IV, unless otherwise specified.

2.10.1 NOT USED

2.10.2 NOT USED

2.10.3 NOT USED

2.10.4 NOT USED

2.10.5 Direct Vents

Both the air intake and exhaust vents shall be sized and located as indicated on the drawings and as recommended by the boiler manufacturer. A separate combustion air intake vent and exhaust vent shall be provided for each boiler.

2.10.5.1 Combustion Air Intake Vent

The combustion air intake piping shall be constructed of Schedule 40 PVC per ASTM D 1784. The vent shall be suitable for the temperature at the boiler combustion air intake connection point. Each intake shall be provided complete with bird screen.

2.10.5.2 Exhaust Vent

The exhaust vent piping shall be constructed of Schedule 40 CPVC or stainless steel conforming to UL 1738 and the boiler manufacturer's recommendations. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. The exhaust vent shall be suitable for the maximum anticipated boiler exhaust temperature and shall withstand the corrosive effects of the condensate. A 8 mm diameter hole shall be provided in the stack not greater than 152 mm from the boiler flue outlet for sampling of the exit gases. A method shall be provided to seal the hole to prevent exhaust gases from entering the boiler room when samples are not being taken. Each exhaust stack shall be provided complete with bird screen.

2.10.6 Expansion Tank

The hot water pressurization system shall include a diaphragm-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 850 kPa (125 psi) and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gauge. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 120 degrees C.

2.10.7 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 850 kPa (125 psi). The capacity of the air separation tank indicated is minimum.

2.10.8 NOT USED

2.10.9 NOT USED

2.10.10 Steel Sheets

2.10.10.1 Galvanized Steel

Galvanized steel shall be ASTM A 653/A 653M.

2.10.10.2 Uncoated Steel

Uncoated steel shall be ASTM A 366/A 366M, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to manufacturer's standard gauge.

2.10.11 Gaskets

Gaskets shall be nonasbestos material in accordance with ASME B16.21, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

2.10.12 Steel Pipe and Fittings

2.10.12.1 Steel Pipe

Steel pipe shall be ASTM A 53/A 53M, Type E or S, Grade A or B, black steel, standard weight.

2.10.12.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.10.12.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

2.10.12.4 Welded Fittings

Welded fittings shall conform to ASTM A 234/A 234M with WPA marking. Buttwelded fittings shall conform to ASME B16.9, and socket-welded fittings shall conform to ASME B16.11.

2.10.12.5 Cast-Iron Fittings

Fittings shall be ASME B16.4, Class 125, type required to match connecting piping.

2.10.12.6 Malleable-Iron Fittings

Fittings shall be ASME B16.3, type as required to match connecting piping.

2.10.12.7 Unions

Unions shall be ASME B16.39, Class 150.

2.10.12.8 Threads

Pipe threads shall conform to ASME B1.20.1.

2.10.12.9 Grooved Mechanical fittings

Joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Fitting and coupling houses shall be ductile iron conforming to ASTM A 536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C . Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.10.13 Copper Tubing and Fittings

2.10.13.1 Copper Tubing

Tubing shall be ASTM B 88, ASTM B 88M, Type L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

2.10.13.2 Solder-Joint Pressure Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M . Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and ASTM B 828.

2.10.13.3 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62.

2.10.13.4 Adapters

Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.10.13.5 Threaded Fittings

Cast bronze threaded fittings shall conform to ASME B16.15.

2.10.13.6 Brazing Material

Brazing material shall conform to AWS A5.8.

2.10.13.7 Brazing Flux

Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent

flushable residue; contain slightly acidic reagents; contain potassium borides, and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.

2.10.13.8 Solder Material

Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

2.10.13.9 Solder Flux

Flux shall be either liquid or paste form, non-corrosive and conform to ASTM B 813.

2.10.13.10 Grooved Mechanical Fittings

Joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Fitting and coupling houses shall be ductile iron conforming to ASTM A 536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsible configuration and shall conform to ASTM D 2000, for circulating medium up to 110 degrees C . Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.10.14 Dielectric Waterways and Flanges

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.10.15 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 861.8 kPa or 1034.2 kPa service. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, and temperature medium. The flexible section shall be suitable for service intended and may have threaded, welded, soldered, flanged, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.10.16 Pipe Supports

Pipe supports shall conform to MSS SP-58 and MSS SP-69.

2.10.17 Pipe Expansion

2.10.17.1 Expansion Loops

Expansion loops and offsets shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops and offsets shall be cold-sprung and installed where indicated. Pipe guides and anchors shall be provided as indicated.

2.10.18 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends per AWWA C606 may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of ASME B31.1. The connection type of all valves shall match the same type of connection required for the piping on which installed.

2.10.18.1 Gate Valves

Gate valves 65 mm and smaller shall conform to MSS SP-80 bronze rising stem, threaded, solder, or flanged ends. Gate valves 80 mm (3 inches) and larger shall conform to MSS SP-70 cast iron bronze trim, outside screw and yoke, flanged, or threaded ends.

2.10.18.2 Globe Valves

Globe valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 80 mm and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.10.18.3 Check Valves

Check valves 65 mm and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Check valves 80 mm and larger shall conform to MSS SP-71, cast iron, bronze trim, flanged, or threaded ends.

2.10.18.4 Angle Valves

Angle valves 65 mm and smaller shall conform to MSS SP-80 bronze, threaded, soldered, or flanged ends. Angle valves 80 mm and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.10.18.5 Ball Valves

Ball valves 15 mm and larger shall conform to MSS SP-72 or MSS SP-110, ductile iron or bronze, threaded, soldered, or flanged ends.

2.10.18.6 Plug Valves

Plug valves 51 mm and larger shall conform to MSS SP-78. Plug valves smaller than 51 mm shall conform to ASME B16.34.

2.10.18.7 Grooved End Valves

Valves with grooved ends per AWWA C606 may be used if the valve manufacturer certifies that their performance meets the requirements of the standards indicated for each type of valve.

2.10.18.8 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow rate can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 120 degrees C temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.10.18.9 Automatic Flow Control Valves

In lieu of the specified balancing valves, automatic flow control valves may be provided to maintain constant flow and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 850 kPa or 150 percent of the system operating pressure, whichever is greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be increased. Valves shall be suitable for 120 degrees C temperature service. Valve materials shall be same as specified for the heating system check, globe, angle, and gate valves. Valve operator shall be the electric motor type or pneumatic type as applicable. Valve operator shall be capable of positive shutoff against the system pump head. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter shall be provided with accessory kit as recommended for the project by the automatic valve manufacturer.

2.10.18.10 Butterfly Valves

Butterfly valves shall be 2-flange type or lug wafer type, and shall be bubbletight at 1135 kPa (150 psig). Valves to be MSS-SP-68, offset seat

type. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 200 mm shall have throttling handles with a minimum of seven locking positions. Valves 200 mm and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valve in insulated lines shall have extended neck to accommodate insulation thickness.

2.10.18.11 Drain valves

Drain valves shall be provided at each drain point of blowdown as recommended by the boiler manufacturer. Piping shall conform to ASME BPVC SEC IVand ASTM A 53/A 53M.

2.10.18.12 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 15 and 70 kPa. The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with ASME BPVC SEC IV, shall be installed so that the discharge will be through piping extended to a location as indicated. Each discharge pipe for hot water service shall be pitched away from the valve seat.

2.10.19 Strainers

Basket and "Y" type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, fabricated of cast iron, and shall have bottoms drilled and tapped with a gate valve attached for blowdown purposes. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment screen. The screen shall be made of 0.795 mm thick monel or corrosion-resistant steel with perforations to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.10.19.1 Strainer Openings

For Pipe Size	Opening Size
Up to 50 mm (2")	.838 mm (.033")
65 mm to 100 mm (2 1/2" - 4")	1.575 mm (.062")
125 mm up (5" up)	3.175 mm (.125")

2.10.20 Pressure Gauges

Gauges shall conform to ASME B40.1 Grade A 1% accuracy, and shall be provided with throttling type needle valve or a pulsation dampener and

shutoff valve. Gauge shall be liquid filled. Minimum dial size shall be 90 mm. A pressure gauge shall be provided for each boiler in a visible location on the boiler; across each pump inlet and outlet flange and in each system return; and elsewhere as indicated. Pressure gauges shall be provided with readings in both Kpa and psi. Pressure gauges shall have an indicating pressure range that is related to the operating pressure of the fluid in accordance with the following table:

Operating Pressure (kPA)	Pressure Range (kPA)
519-1030	0-1400
105-518	0-690
14-104	0-210 (retard)

Operating Pressure (psi)	Pressure Range (psi)
76-150	0-200
16-75	0-100
2-15	0-30 (retard)

2.10.21 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant steel sockets. Mercury shall not be used in thermometers. Thermometers for inlet water and outlet water for each hot water boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 225 mm (9 inch) scale. The operating range of the thermometers shall be 0-100 degrees centigrade (32 - 212 degrees Fahrenheit). Gauges shall be ASME B 403, Grade A (1%) accuracy. The thermometers shall be provided with readings in degrees Celsius and Fahrenheit.

2.10.22 Air Vents

2.10.22.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

2.10.22.2 Automatic Air Vents

Automatic air vents shall be 20 mm quick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein, and a thermostatic member that will close the port against the passage of steam from the system. The name of the manufacturer shall

be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

2.11 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section 16415A ELECTRICAL WORK, INTERIOR. Motors which are not an integral part of a packaged boiler shall be rated for high efficiency service. Motors which are an integral part of the packaged boiler shall be the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices but not shown shall be provided.

2.11.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 375 W (1/2 hp) and larger shall be three-phase, unless otherwise indicated. Motors shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

2.11.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 7.46 kW (10 hp) ratings. Adjustable frequency drives shall be used for larger motors.

2.12 INSULATION

Shop and field-applied insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.13 TOOLS

Special tools shall be furnished. Special tools shall include uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet, mounted where directed.

2.13.1 NOT USED

2.13.2 Tube Cleaner

If a watertube boiler is being furnished, a water-driven tube cleaner with three rotary cutters and rotary wire brush complete with the necessary length of armored water hose, valves, and other appurtenances necessary for operation shall be provided. Tube cleaner and rotary brush shall be provided for each size of water tube in the boiler, with one extra set of cutters for each size cleaner. Necessary valves and fittings shall be provided to permit ready connection of the cleaner hose to a high-pressure pump for cold water supply to operate the cleaner.

2.13.3 NOT USED

2.13.4 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. Gaskets shall be packaged and properly identified.

2.14 NOT USED

2.15 BOILER WATER TREATMENT

2.15.1 Make Up Water Conditions

The makeup water conditions shall be measured and determined by the Contractor from examining existing potable water supply at this facility, and shall be reported to the Contracting Officer per ASTM D 596.

2.15.2 Boiler Water Limits

The boiler manufacturer shall be consulted for the determination of the boiler water chemical composition limits. The boiler water limits shall be as follows unless dictated differently by the boiler manufacturer's recommendations:

Sodium Sulfite	20-40 ppm
Hardness	Less than 2 ppm
pH	9.3 - 9.9

2.15.3 NOT USED

2.15.4 NOT USED

2.15.5 NOT USED

2.15.6 NOT USED

2.15.7 NOT USED

2.15.8 NOT USED

2.15.9 NOT USED

2.15.10 Chemical Shot Feeder

Provide a 5.7 liter (1.5 gal) chemical pot feeder for the heating hot water system. Provide the feeders consisting of a welded steel body, funnel and funnel valve, air vent and drain petcocks and outlet valve. Pipe each feeder in a 3-way bypass across the pump so that the flow is in the bottom and out the top of the unit. Mount the unit on the wall not more than 1200 mm (48 inches) above the floor.

PART 3 EXECUTION

3.1 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 40 degrees C. Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler combustion air intake and flue exhaust ductwork shall be as indicated with full provision for expansion and contraction between all interconnected components.

3.2 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 100 mm and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 0.2 percent. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 65 mm or less in diameter and with flanges for pipe 80 mm or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the

lines at the same level to prevent air binding.

3.2.1 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above 110 degrees C (230 degrees F).

3.2.2 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

3.2.3 Gauge Piping

Piping shall be copper tubing.

3.2.4 NOT USED

3.2.5 NOT USED

3.2.6 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 25 mm and smaller shall be threaded; fittings 32 mm and up to but not including 80 mm shall be either threaded, grooved, or welded; and fittings 80 mm and larger shall be either flanged, grooved, or welded. Pipe and fittings 32 mm and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 65 mm or smaller in diameter and with flanges for pipe 80 mm inches or larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

3.2.6.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

3.2.6.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external

strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1.5 mm and no more than 3 mm.

3.2.6.3 Grooved Mechanical Joints

Grooved mechanical joints may be provided for hot water systems in lieu of unions, welded, flanged, or screwed piping connections in low temperature hot water systems where the temperature of the circulating medium does not exceed 110 degrees C. Grooves shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations. Mechanical joints shall use rigid mechanical pipe couplings, except at equipment connections. At equipment connections, flexible couplings may be used. Coupling shall be of the bolted type for use with grooved end pipes, fittings, valves, and strainers. Couplings shall be self-centering and shall engage in a watertight couple.

3.2.6.4 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube Handbook with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

3.2.6.5 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 50 mm and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube Handbook.

3.2.6.6 Copper Tube Extracted Joint

An extruded mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.7 Flanges and Unions

Flanges shall be faced true, provided with 1.6 mm thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

3.2.8 Branch Connections

3.2.8.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 8 mm in 1 m. When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

3.2.9 NOT USED

3.2.10 NOT USED

3.2.11 NOT USED

3.2.12 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and

notching of straight runs of pipe for tees will not be permitted. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with MSS SP-73, and CDA Tube Handbook. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 50 mm or smaller. Soldered joints shall conform to ASME B31.5 and shall be in accordance with CDA Tube Handbook.

3.2.13 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.14 Supports

Hangers used to support piping 50 mm and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. Threaded rods which are used for support shall not be formed or bent.

3.2.14.1 NOT USED

3.2.14.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1500 mm apart at valves.

h. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 4500 mm, not more than 2400 mm from end of risers, and at vent terminations.

i. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

(1) Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 100 mm (4 inches) and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 100 mm (4 inches), a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.

(2) Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm or by an amount adequate for the insulation, whichever is greater.

j. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

k. Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05120A STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist between panel points shall not

exceed 22 kg. Loads exceeding 22 kg shall be suspended from panel points.

3.2.14.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 3 mm shall be provided between the pipe insulation and the clip or clamp for piping which may be subjected to thermal expansion.

3.2.15 Anchors

Anchors shall be provided where necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Detailed drawings of pipe anchors shall be submitted for approval before installation.

3.2.16 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 1.5 m on each side of each expansion joint, and in lines 100 mm (4 inches) or smaller not more than 600 mm on each side of the joint.

3.2.17 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction. Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

3.2.18 Pipe Sleeves

Pipe passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall extend above top surface of floor a sufficient distance to allow proper flashing or finishing. Sleeves through roofs

shall extend above the top surface of roof at least 150 mm for proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 6 mm between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, and wet areas shall be galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section 07900A JOINT SEALING. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, floors, or roofs.

a. Metal jackets shall not be thinner than 0.1524 mm (0.006 inch) thick aluminum, if corrugated, and 0.4 mm (0.016 inch) thick aluminum, if smooth.

b. Metal jackets shall be secured with aluminum or stainless steel bands not less than 9 mm wide and not more than 200 mm apart. When penetrating roofs and before fitting the metal jacket into place, a 15 mm wide strip of sealant shall be run vertically along the inside of the longitudinal joint of the metal jacket from a point below the backup material to a minimum height of 1000 mm above the roof. If the pipe turns from vertical to horizontal, the sealant strip shall be run to a point just beyond the first elbow. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm above material to a minimum distance of 50 mm above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm above the floor; when passing through walls above grade, the jacket shall extend at least 100 mm beyond each side of the wall.

3.2.18.1 NOT USED

3.2.18.2 NOT USED

3.2.18.3 Optional Counterflashing

As alternates to caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may consist of standard roof coupling for threaded pipe up to 150 mm (6 inches) in diameter, lead flashing sleeve for dry vents with the sleeve turned down into the pipe to form a waterproof joint, or a tack-welded or banded-metal rain shield around the pipe, sealed as indicated.

3.2.18.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840A FIRESTOPPING.

3.2.19 Balancing Valves

Balancing valves shall be installed as indicated.

3.2.20 Thermometer Wells

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

3.2.21 Air Vents

Air vents shall be installed where shown or directed. Air vents shall be installed in piping at all system high points. The vent shall remain open until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

3.2.22 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

3.2.23 Drains

A drain connection with a 25 mm (1 inch) gate valve or 20 mm (3/4 inch) hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on each unit heater or unit ventilator and wherever required for thorough draining of the system.

3.2.24 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down valve.

3.2.25 Direct Venting for Combustion Intake Air and Exhaust Air

The intake air and exhaust vents shall be installed in accordance with NFPA 54 and boiler manufacturer's recommendations. The exhaust vent shall be sloped 20.8 mm per m (1/4 inch per ft) toward the boiler's flue gas condensate collection point.

3.3 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with the Section 15190A GAS PIPING SYSTEMS. NFPA 54 shall be complied with unless otherwise specified. Burners, pilots, and all accessories shall be listed in UL Gas&Oil Dir. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure

gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and other components required for safe, efficient, and reliable operation as specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

3.4 NOT USED

3.5 RADIANT FLOOR HEATING SYSTEM

The radiant floor heating system shall be installed in accordance with HYI-400, unless otherwise indicated by the tubing manufacturer's installation instructions. During the installation, all tubing shall be plugged on each end to prevent foreign materials from entering the tubing. All tubing shall be checked for abrasions prior to installation. Tubing with excessive abrasions that damage the oxygen barrier coating will not be acceptable. Tubing with any abrasion that is greater than 10 percent of the minimum wall thickness will not be acceptable. All tubing embedded or concealed by the floor shall be installed without joints. The bending radius of the tubing shall not exceed the values recommended by the tubing manufacturer. The tubing shall be installed in such a manner as to evenly distribute the heat across the floor. Isolation valves shall be installed on each side of each tubing manifold. The manifold and fittings shall be accessible for maintenance. After the system is filled with water or glycol, all air shall be vented from the system. After the system is allowed to stabilize at the operating temperatures of the heating fluid, the system shall be vented again. Coordinate with concrete floor slab pour to install tubing on bottom layer of rebar.

3.5.1 Concrete Slab construction

In areas where tubing must cross control joints, or other crack control measures, the tubing shall be installed below the joints. The tubing shall be fastened to the reinforcing steel in accordance with the tubing manufacturer's recommendations. The tubing shall be pressurized prior to and during the concrete pour to ensure system integrity.

3.6 COLOR CODE MARKING AND FIELD PAINTING

Color code marking of piping shall be as specified in Section 09900 PAINTING GENERAL. Ferrous metal not specified to be coated at the factory shall be cleaned, prepared, and painted as specified in Section 09900 PAINTING, GENERAL. Exposed pipe covering shall be painted as specified in Section 09900 PAINTING, GENERAL. Aluminum sheath over insulation shall not be painted.

3.7 TEST OF BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall be tested in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

3.8 HEATING SYSTEM TESTS

Before any covering is installed on pipe or heating equipment, the entire

heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1-1/2 times the design working pressure, but not less than 689 kPa. Before pressurizing system for test, items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure shall be blanked off or replaced with spool pieces. Before balancing and final operating test, test blanks and spool pieces shall be removed; and protected instruments and equipment shall be reconnected. With equipment items protected, the system shall be pressurized to test pressure. Pressure shall be held for a period of time sufficient to inspect all welds, joints, and connections for leaks, but not less than 2 hours. No loss of pressure will be allowed. Leaks shall be repaired and repaired joints shall be retested. Repair joints shall not be allowed under the floor for floor radiant heating systems. If a leak occurs in tubing located under the floor in radiant heating systems, the entire zone that is leaking shall be replaced. If any repair is made above the floor for floor radiant heating systems, access shall be provided for the installed joint. Caulking of joints shall not be permitted. System shall be drained and after instruments and equipment are reconnected, the system shall be refilled with service medium and maximum operating pressure applied. The pressure shall be held while inspecting these joints and connections for leaks. The leaks shall be repaired and the repaired joints retested. Upon completion of hydrostatic tests and before acceptance of the installation, the Contractor shall balance the heating system in accordance with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS; and operating tests required to demonstrate satisfactory functional and operational efficiency shall be performed. The operating test shall cover a period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report, together with conclusions as to the adequacy of the system:

a. Certification of balancing.

b. Time, date, and duration of test.

c. Outside and inside dry bulb temperatures.

d. Temperature of hot water supply leaving boiler.

e. Temperature of heating return water from system at boiler inlet.

f. Boiler make, type, serial number, design pressure, and rated capacity.

g. Fuel burner make, model, and rated capacity; ammeter and voltmeter readings for burner motor.

h. Circulating pump make, model, and rated capacity, and ammeter and voltmeter readings for pump motor during operation.

i. Flue-gas temperature at boiler outlet.

j. Percent carbon dioxide in flue-gas.

k. Grade or type and calorific value of fuel.

l. Quantity of water circulated.

m. Quantity of fuel consumed.

n. Stack emission pollutants concentration.

Indicating instruments shall be read at half-hour intervals unless otherwise directed. The Contractor shall furnish all instruments, equipment, and personnel required for the tests and balancing. Fuels, water, and electricity shall be obtained as specified in the SPECIAL CONTRACT REQUIREMENTS. Operating tests shall demonstrate that fuel burners and combustion and safety controls meet the requirements of ASME CSD-1, ANSI Z21.13, and NFPA 8501.

3.8.1 Water Treatment Testing

3.8.1.1 Water Quality Test

The boiler water shall be analyzed prior to the acceptance of the facility by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	_____	
Temperature	_____	degrees C
Silica (SiO_2)	_____	ppm (mg/1)
Insoluble	_____	ppm (mg/1)
Iron and Aluminum Oxides	_____	ppm (mg/1)
Calcium (Ca)	_____	ppm (mg/1)
Magnesium (Mg)	_____	ppm (mg/1)
Sodium and Potassium (Na and K)	_____	ppm (mg/1)
Carbonate (HCO_3)	_____	ppm (mg/1)
Sulfate (SO_4)	_____	ppm (mg/1)
Chloride (C1)	_____	ppm (mg/1)
Nitrate (NO_3)	_____	ppm (mg/1)
Turbidity	_____	unit
pH	_____	
Residual Chlorine	_____	ppm (mg/1)
Total Alkalinity	_____	epm (meq/1)
Noncarbonate Hardness	_____	epm (meq/1)
Total Hardness	_____	epm (meq/1)
Dissolved Solids	_____	ppm (mg/1)
Fluorine	_____	ppm (mg/1)
Conductivity	_____	micro-mho/cm

If the boiler water is not in conformance with the boiler manufacturer's recommendations, the water treatment company shall take corrective action.

3.8.1.2 Boiler/Piping Test

At the conclusion of the 1 year period, the boiler piping shall be inspected for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water

treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.9 CLEANING

3.9.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boiler shall be thoroughly cleaned by filling the system with a solution consisting of either 0.5 kg of caustic soda or 0.5 kg of trisodium phosphate per 100 L of water. The proper safety precautions shall be observed in the handling and use of these chemicals. The water shall be heated to approximately 65 degrees C and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

3.9.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for fans that are operated during construction, and new filters shall be installed after construction dirt has been removed from the building, and the ducts, plenum, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.10 FUEL SYSTEM TESTS

3.10.1 NOT USED

3.10.2 Gas System Test

The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA 54.

3.11 FIELD TRAINING

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer and (2) preventive maintenance personnel. The training period shall consist of a total of 24 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance

instructions, as well as demonstrations of routine maintenance operations and boiler safety devices. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

-- End of Section --

SECTION 15620A

LIQUID CHILLERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 550/590	(1998) Water-Chilling Packages Using the Vapor Compression Cycle
ARI 700	(1999) Specifications for Fluorocarbon and Other Refrigerants

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 520	(2000) Zinc Dust Pigment
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM F 104	(1995) Nonmetallic Gasket Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE 34	(1997) Number Designation and Safety Classification of Refrigerants

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(1999) Safety in Welding and Cutting

ASME INTERNATIONAL (ASME)

ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators
NEMA MG 2	(1989) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G, RE
Installation; G, RE

Drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and all interconnected or interlocked relationships between components.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations.

e. Details, if piping and equipment are to be supported other

than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

SD-03 Product Data

Refrigeration System; G, RE

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be adequate to demonstrate compliance with contract requirements as specified within the paragraphs:

a. Liquid Chiller

b. Chiller Components

c. Accessories

If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Spare Parts

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Posted Instructions

Posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

Manufacturer's Multi-Year Compressor Warranty

Manufacturer's multi-year warranty for compressor(s) in air-cooled liquid chillers as specified.

System Performance Tests

A schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

SD-06 Test Reports

System Performance Tests

Six copies of the report shall be provided in bound 216 x 279 (8 1/2 x 11 inch) booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 3 degrees C (5 degrees F) apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:

(1) The refrigerant used in the system.
(2) The condensing temperature and pressure.
(3) Suction temperature and pressure.
(4) Running current, voltage and proper phase sequence for each phase of all motors.
(5) The actual on-site setting of all operating and safety controls.
(6) Chilled water pressure, flow and temperature in and out of the chiller.
(7) The position of the capacity-reduction gear at machine off, one-third loaded, one-half loaded, two-thirds loaded, and fully loaded.

SD-07 Certificates

Refrigeration System

Where the system, components, or equipment are specified to

comply with requirements of AGA, NFPA, ARI, ASHRAE, ASME, or UL, 1 copy of proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

Service Organization

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Operation Manuals; G, RE

Six complete copies of an operation manual in bound 216 x 279 (81/2 x 11 inch) booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manuals; G, RE

Six complete copies of maintenance manual in bound 216 x 279 (81/2 x 11 inch) booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so

that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.6 MANUFACTURER'S MULTI-YEAR COMPRESSOR WARRANTY

The Contractor shall provide a 5 year parts and labor (includes refrigerant) manufacturer's warranty on the air-cooled chiller compressor(s). This warranty shall be directly from the chiller manufacturer to the Government and shall be in addition to the standard one-year warranty of construction. The manufacturer's warranty shall provide for the repair or replacement of the chiller compressor(s) that become inoperative as a result of defects in material or workmanship within 5 years after the date of final acceptance. When the manufacturer determines that a compressor requires replacement, the manufacturer shall furnish new compressor(s) at no additional cost to the Government. Upon notification that a chiller compressor has failed under the terms of the warranty, the manufacturer shall respond in no more than 6 hours. Response shall mean having a manufacturer-qualified technician onsite to evaluate the extent of the needed repairs. The warranty period shall begin on the same date as final acceptance and shall continue for the full product warranty period.

1.6.1 NOT USED

1.6.2 Local Service Representative

The Contractor shall furnish with each manufacturer's multi-year warranty the name, address, and telephone number (day, night, weekend, and holiday)

of the service representative nearest to the location where the equipment is installed. Upon a request for service under the multi-year warranty, the service representative shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty.

1.6.3 Equipment Warranty Tags

At the time of installation, each item of manufacturer's multi-year warranted equipment shall be tagged with a durable, oil- and water-resistant tag, suitable for interior and exterior locations, resistant to solvents, abrasion, and fading due to sunlight. The tag shall be attached with copper wire or a permanent, pressure-sensitive, adhesive backing. The tag shall be installed in an easily noticed location attached to the warranted equipment. The tag for this equipment shall be similar to the following in format, and shall contain all of the listed information:

MANUFACTURER'S MULTI-YEAR WARRANTY EQUIPMENT TAG
Equipment/Product Covered: _____
Manufacturer:_____Model No.:_____Serial No.:__
Warranty Period: From _____to _____
Contract No.: _____
Warranty Contact: _____
Name: _____
Address: _____
Telephone: _____
STATION PERSONNEL SHALL PERFORM PREVENTIVE MAINTENANCE AND OPERATIONAL MAINTENANCE

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including chillers, compressors, compressor drivers, condensers, liquid coolers, receivers, refrigerant leak detectors, heat exchanges, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate

secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 746 kW (1 hp) and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 SELF-CONTAINED LIQUID CHILLER

Unless necessary for delivery purposes, units shall be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the factory. In lieu of delivery constraints, a chiller may be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the job site by a factory representative. Unit components delivered separately shall be sealed and charged with a nitrogen holding charge. Unit assembly shall be completed in strict accordance with manufacturer's recommendations. Chiller shall operate within capacity range and speed recommended by the manufacturer. Parts weighing 23 kg or more which must be removed for inspection, cleaning, or repair, such as motors, gear boxes, cylinder heads, casing tops, condenser, and cooler heads, shall have lifting eyes or lugs. Chiller shall include all customary auxiliaries deemed necessary by the manufacturer for safe, controlled, automatic operation of the equipment. Chiller shall be provided with a single point wiring connection for incoming power supply. Chiller's condenser and liquid cooler shall be provided with marine water boxes with flanged connections.

2.4.1 Rotary Screw Type

Chiller shall be constructed and rated in accordance with ARI 550/590. Chiller shall be conform to ASHRAE 15. Chiller shall have a minimum full

load COP rating and part load COP rating as scheduled in accordance with ARI 550/590. As a minimum, chiller shall include the following components as defined in paragraph CHILLER COMPONENTS.

a. Refrigerant and oil

b. Structural base

c. Chiller refrigerant circuit

d. Controls package

e. Rotary screw compressor

f. Compressor driver, electric motor

g. Compressor driver connection

h. Liquid cooler (evaporator)

i. Air-cooled condenser coil

j. Tools

2.5 NOT USED

2.6 CHILLER COMPONENTS

2.6.1 Refrigerant and Oil

Refrigerants shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05.

2.6.2 Structural Base

Chiller and individual chiller components shall be provided with a factory-mounted structural steel base (welded or bolted) or support legs. Chiller and individual chiller components shall be isolated from the building structure by means of molded neoprene isolation pads, and vibration isolators with published load ratings. Vibration isolators shall have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.

2.6.3 Chiller Refrigerant Circuit

Chiller refrigerant circuit shall be completely piped and factory leak tested. For multicompressor units, not less than 2 independent refrigerant circuits shall be provided. Circuit shall include as a minimum a combination filter and drier, combination sight glass and moisture indicator, liquid-line solenoid valve for reciprocating, an electronic or thermostatic expansion valve with external equalizer, charging ports,

compressor service valves for field-serviceable compressors, and superheat adjustment.

2.6.4 Controls Package

Chiller shall be provided with a complete factory-mounted, prewired electric or microprocessor based control system. Controls package shall contain as a minimum a digital display or acceptable gauges, an on-auto-off switch, power wiring, and control wiring. Controls package shall provide operating controls, monitoring capabilities, programmable setpoints, safety controls, and EMCS interfaces as defined below.

2.6.4.1 Operating Controls

Chiller shall be provided with the following adjustable operating controls as a minimum.

a. Leaving chilled water temperature control

b. Adjustable timer or automated controls to prevent a compressor from short cycling

c. Automatic lead/lag controls (adjustable) for multi-compressor units

d. Load limiting

e. System capacity control to adjust the unit capacity in accordance with the system load and the programmable setpoints. Controls shall automatically re-cycle the chiller on power interruption.

f. Startup and head pressure controls to allow system operation at all ambient temperatures down to -18 degrees C.

2.6.4.2 Monitoring Capabilities

During normal operations, the control system shall be capable of monitoring and displaying the following operating parameters. Access and operation of display shall not require opening or removing any panels or doors.

a. Entering and leaving chilled water temperatures

b. Self diagnostic

c. Operation status

d. Operating hours

e. Number of starts

f. Compressor status (on or off)

g. Refrigerant discharge and suction pressures

h. Oil pressure

2.6.4.3 Programmable Setpoints

The control system shall be capable of being reprogrammed directly at the unit. The programmable setpoints shall include the following as a minimum.

a. Leaving Chilled Water Temperature

b. Time Clock/Calender Date

2.6.4.4 Safety Controls with Manual Reset

Chiller shall be provided with the following safety controls which automatically shutdown the chiller and which require manual reset.

a. Low chilled water temperature protection

b. High condenser refrigerant discharge pressure protection

c. Low evaporator pressure protection

d. Chilled water flow detection

e. High motor winding temperature protection

f. Low oil flow protection if applicable

g. Motor current overload and phase loss protection

2.6.4.5 Safety Controls with Automatic Reset

Chiller shall be provided with the following safety controls which automatically shutdown the chiller and which provide automatic reset.

a. Over/under voltage protection

b. Chilled water flow interlock

2.6.4.6 Remote Alarm

During the initiation of a safety shutdown, a chiller's control system shall be capable of activating a remote alarm bell. In coordination with the chiller, the contractor shall provide an alarm circuit (including transformer if applicable) and a minimum 100 mm (4 inch) diameter alarm bell. Alarm circuit shall activate bell in the event of machine shutdown due to the chiller's monitoring of safety controls. The alarm bell shall not sound for a chiller that uses low-pressure cutout as an operating control.

2.6.4.7 Energy Management Control System (EMCS) Interface

The control system shall be capable of communicating all data to a remote integrated DDC processor through a single shielded cable. The data shall include as a minimum all system operating conditions, capacity controls,

and safety shutdown conditions. The control system shall also be capable of receiving at a minimum the following operating commands.

a. Remote Unit Start/Stop

b. Remote Chilled Water Reset

2.6.5 Compressor(s)

2.6.5.1 NOT USED

2.6.5.2 NOT USED

2.6.5.3 Rotary Screw Compressor(s)

Compressors shall operate stably for indefinite time periods at any stage of capacity reduction without hot-gas bypass. Provision shall be made to insure proper lubrication of bearings and shaft seals on shutdown with or without electric power supply. Rotary screw compressors shall include:

a. An open or hermetic, positive displacement, oil-injected design directly driven by the compressor driver. Compressor shall allow access to internal compressor components for repairs, inspection, and replacement of parts.

b. Rotors which are solid steel forging with sufficient rigidity for proper operation.

c. A maximum rotor operating speed no greater than 3600 RPM.

d. Casings of cast iron, precision machined for minimal clearance about periphery of rotors.

e. A lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.

f. Shaft main bearings of the sleeve type with heavy duty bushings or rolling element type in accordance with ABMA 9 or ABMA 11. Bearings shall be conservatively loaded and rated for an L(10) life of not less than 200,000 hours.

g. A differential oil pressure or flow cutout to allow the compressor to operate only when the required oil pressure or flow is provided to the bearings.

h. A temperature- or pressure-initiated, hydraulically actuated, single-slide-valve, capacity-control system to provide minimum automatic capacity modulation from 100 percent to 15 percent.

i. An oil separator and oil return system to remove oil entrained in the refrigerant gas and automatically return the oil to the compressor.

j. Crankcase oil heaters controlled as recommended by the

manufacturer.

2.6.6 NOT USED

2.6.7 NOT USED

2.6.8 NOT USED

2.6.9 NOT USED

2.6.10 Liquid Cooler (Evaporator)

Cooler shall be of the shell-and-coil or shell-and-tube type design. Condenser's refrigerant side shall be designed and factory pressure tested to comply with ASHRAE 15. Condenser's water side shall be designed and factory pressure tested for not less than 1,000 kPa. Cooler shell shall be constructed of seamless or welded steel. Coil bundles shall be totally removable and arranged to drain completely. Tubes shall be seamless copper, plain, integrally finned with smooth bore or integrally finned with enhanced bore. Each tube shall be individually replaceable. Tubes shall be installed into carbon mild steel tube sheets by rolling. Tube baffles shall be properly spaced to provide adequate tube support and cross flow. Performance shall be based on a water velocity not less than 0.91 m/s (3 fps) nor more than 3.7 mm (12 fps).

2.6.11 Air-Cooled Condenser Coil

Condenser coil shall be of the extended-surface fin-and-tube type and shall be constructed of seamless copper tubes with compatible copper fins. Fins shall be soldered or mechanically bonded to the tubes and installed in a metal casing. Coils shall be circuited and sized for a minimum of 3 degrees C subcooling and full pumpdown capacity. Coil shall be factory leak and pressure tested after assembly in accordance with ASHRAE 15. Coil shall be entirely coated with the manufacturer's standard epoxy or vinyl coating.

2.6.12 NOT USED

2.6.13 NOT USED

2.6.14 NOT USED

2.6.15 NOT USED

2.6.16 Tools

One complete set of special tools, as recommended by the manufacturer for field maintenance of the system, shall be provided. Tools shall be mounted on a tool board in the equipment room or contained in a toolbox as directed by the Contracting Officer.

2.7 NOT USED

2.8 ACCESSORIES

2.8.1 NOT USED

2.8.2 NOT USED

2.8.3 NOT USED

2.8.4 NOT USED

2.8.5 NOT USED

2.8.6 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 371 degrees C (700 degrees F) service.

2.8.7 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

2.9 FABRICATION

2.9.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 3 mm on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.9.2 Factory Applied Insulation

Chiller shall be provided with factory installed insulation on surfaces subject to sweating including the liquid cooler, suction line piping, economizer, and cooling lines. Insulation on heads of coolers may be field applied, however it shall be installed to provide easy removal and replacement of heads without damage to the insulation. Where motors are the gas-cooled type, factory installed insulation shall be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in

attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

2.10 NOT USED

2.11 SUPPLEMENTAL COMPONENTS/SERVICES

2.11.1 Chilled Water Piping and Accessories

Chilled water piping and accessories shall be provided and installed in accordance with Section 15181A CHILLED WATER PIPING AND ACCESSORIES.

2.11.2 Refrigerant Piping

Refrigerant piping for split-system liquid chillers shall be provided and installed in accordance with Section 15182A REFRIGERANT PIPING.

2.11.3 NOT USED

2.11.4 Temperature Controls

Chiller control packages shall be fully coordinated with and integrated into the temperature control system specified in Section 15951A DDC CONTROL SYSTEMS.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D1and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

3.1.1 Refrigeration System

3.1.1.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, liquid coolers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall

be set on not less than a 150 mm concrete pad doweled in place. Concrete foundations for floor mounted pumps shall have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.1.1.2 Field Refrigerant Charging

a. Initial Charge: Upon completion of all the refrigerant pipe tests, the vacuum on the system shall be broken by adding the required charge of dry refrigerant for which the system is designed, in accordance with the manufacturer's recommendations. Contractor shall provide the complete charge of refrigerant in accordance with manufacturer's recommendations. Upon satisfactory completion of the system performance tests, any refrigerant that has been lost from the system shall be replaced. After the system is fully operational, service valve seal caps and blanks over gauge points shall be installed and tightened.

b. Refrigerant Leakage: If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant shall be pumped into the system receiver or other suitable container. The refrigerant shall not be discharged into the atmosphere.

c. Contractor's Responsibility: The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 85 g of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the specified requirements including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.1.1.3 Oil Charging

Except for factory sealed units, two complete charges of lubricating oil

for each compressor crankcase shall be furnished. One charge shall be used during the performance testing period, and upon the satisfactory completion of the tests, the oil shall be drained and replaced with the second charge.

3.1.2 NOT USED

3.1.3 Field Applied Insulation

Field installed insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.4 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTING, GENERAL.

3.2 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative shall be provided for 2 days. The representative shall advise on the following:

a. Hermetic machines:

(1) Testing hermetic water-chilling unit under pressure for refrigerant leaks; evacuation and dehydration of machine to an absolute pressure of not over 300 microns.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

3.3 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing shall be as specified in Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.4 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each

system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Field tests shall be coordinated with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff and preventive maintenance contractor personnel as designated by the Contracting Officer. The training period shall consist of a total 24 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

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SECTION 15700R

UNITARY HEATING AND COOLING EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 210/240	(1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 460	(2000) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI 700	(1999) Specifications for Fluorocarbons and Other Refrigerants

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 520	(1984; R 1995el) Zinc Dust Pigment
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE 34	(1997) Number Designation and Safety Classification of Refrigerants

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(1999) Safety in Welding and Cutting

ASME INTERNATIONAL (ASME)

ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA MG 1	(1998) Motors and Generators
NEMA MG 2	(1989) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1995	(1995; Rev thru Aug 1999) Heating and Cooling Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G, RE

Drawings provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment

indicated or required to have concrete foundations.

e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

f. Automatic temperature control diagrams and control sequences.

g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

SD-03 Product Data

Unitary Equipment; G, RE

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Data shall be submitted for each specified component.

Spare Parts Data

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Posted Instructions

Posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

System Performance Tests

A schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations; G, RE

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up; G, RE

Six copies of each test containing the information described below in bound 216 x 279 mm (8-1/2 x 11 inch) booklets. Individual reports shall be submitted for the refrigerant system tests.

a. The date the tests were performed.

b. A list of equipment used, with calibration certifications.

c. Initial test summaries.

d. Repairs/adjustments performed.

e. Final test results.

System Performance Tests; G, RE

Six copies of the report provided in bound 216 x 279 mm (8-1/2 x 11 inch) booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 3 degrees C apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:

(1) The refrigerant used in the system.
(2) Condensing temperature and pressure.
(3) Suction temperature and pressure.
(4) Ambient, condensing and coolant temperatures.
(5) Running current, voltage and proper phase sequence for each phase of all motors.

c. The actual on-site setting of operating and safety controls.

d. Thermostatic expansion valve superheat - value as determined by field test.

e. Subcooling.

f. High and low refrigerant temperature switch set-points

g. Low oil pressure switch set-point.

h. Defrost system timer and thermostat set-points.

i. Moisture content.

j. Capacity control set-points.

k. Field data and adjustments which affect unit performance and energy consumption.

l. Field adjustments and settings which were not permanently marked as an integral part of a device.

SD-07 Certificates

Unitary Equipment

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

Service Organization

A certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Operation Manuals

Six complete copies of an operation manual in bound 216 x 279 (81/2 x 11 inch) booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manuals

Six complete copies of maintenance manual in bound 216 x 279 mm (8-1/2 x 11 inch) booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection,

electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of stainless steel anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 746 kW (1 hp) and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor

terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 UNITARY EQUIPMENT, ROOM UNIT

2.4.1 NOT USED

2.4.2 Packaged Terminal Unit

Unit shall be a through-the-wall mounted, heavy-duty commercial grade, factory-assembled and precharged air-conditioner unit. Unit shall be in accordance with ARI 310/380 and UL 1995. Units shall be removable from inside the building for servicing without removing the outside cabinet. Unit shall have a noise rating in accordance with ARI 350 and shall have no loose panel rattles or buzzes, transmitted noise from compressor isolation bridging, or similar noise emittances. Unit shall be considered quiet in comparison with its competitive peer products, while the entire unit is operating at any fan or compressor speed. An outdoor coil temperature sensor shall be provided to guard against coil freeze-up. Provide with subbase kit, power disconnect switch, condensate drain kit to direct condensate out external to building and extruded aluminum outdoor architectural grilles.

2.4.3 Compressor

Compressor shall be hermetically sealed rotary type. Compressor shall be fitted with permanent split capacitor motor, overload protection, and vibration isolators. Compressor shall be protected against high discharge pressure, loss of charge, low voltage, and short cycling.

2.4.4 Air-To-Refrigerant Coils

Evaporator and condenser coils shall have copper or aluminum tubes of 10 mm (3/8 inch) minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 0.076 mm thick phenolic or vinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. A condensate removal system shall be provided.

2.4.5 Fans

Indoor and outdoor fans shall be the centrifugal, direct driven type. Fans shall be statically and dynamically balanced. Outdoor fan shall be designed so that condensate will evaporate without drip, splash, or spray on building exterior. Indoor fan shall be provided with a minimum

two-speed motor with built-in overload protection. Fan motors shall be the inherently protected, permanent split-capacitor type.

2.4.6 Air Filters

Filters shall be of the sectional or panel cleanable type and be capable of filtering the entire air supply.

2.4.7 Primary/Supplemental Heat

Primary heat shall be provided as scheduled.

2.4.8 Cabinet Construction

Cabinet shall be free of visible fasteners, sharp protuberances and edges. Enclosure sheet metal shall be a minimum of 1.2 mm (18 gauge) steel with a protective coating. Face panels shall be removable and shall provide full access to unit appurtenances. Access to controls shall be without removal of the face panel. Conditioned air shall discharge through adjustable louvers. Cabinet shall be thermally and acoustically insulated with materials which conform to NFPA 90A. Units shall be furnished with a field-wired subbase. Subbase shall have leveling screws without provisions for remote unit control. Subbase shall be of 1.3 mm (18 gauge) galvanized steel construction with a protective coating to match that of the room cabinet. Paint and finishes shall comply with the requirements specified in paragraph FACTORY COATING.

2.4.9 Wall Sleeve

Louver shall be stormproof type, constructed of anodized, stamped or extruded aluminum. Sleeve shall be a water and airtight noninsulated assembly, with weather-resistant protective coating.

2.4.10 NOT USED

2.4.11 Unit Controls

Controls shall include an on-off switch, high and low selector switch for both the heating and cooling mode, multiple speed fan cooling and heating mode, room air fan switch, outside air damper control, and an adjustable cooling and heating thermostat. Function and temperature controls shall be integral to unit.

2.5 NOT USED

2.6 UNITARY EQUIPMENT, SPLIT SYSTEM

Unit shall be an air-cooled, split system which employs a remote condensing unit, a separate indoor unit, and interconnecting refrigerant piping. Unit shall be the air-conditioning type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be rated in accordance with ARI 210/240. Unit shall be provided with necessary fans, air filters, internal dampers, mixing boxes, supplemental heat, and cabinet construction as specified in paragraph "System Components". The remote

unit shall be as specified in paragraph REMOTE CONDENSER OR CONDENSING UNIT. Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type. Condenser or outdoor fans shall be the manufacturer's standard for the unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors shall have open dripproof enclosures.

2.6.1 Air-to-Refrigerant Coil

Coils shall have copper or aluminum tubes of 10 mm (3/8 inch) minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 0.076 mm thick phenolic or vinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.6.2 NOT USED

2.6.3 Refrigeration Circuit

Refrigerant-containing components shall comply with ASHRAE 15 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type.

2.6.4 Unit Controls

Unit shall be internally prewired with a 24 volt control circuit powered by an internal transformer. Terminal blocks shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high and low pressure, and low oil pressure for compressors with positive displacement oil pumps, and safety interlocks on all service panels. Adjustable-cycle timers shall prevent short-cycling. Multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker in accordance with UL 1995.

2.7 REMOTE CONDENSER OR CONDENSING UNIT

Each remote condenser coil shall be fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature shall not exceed 49 degrees C (120 degrees F) at 40 degrees C (95 degrees F) ambient. Fan and cabinet construction shall be provided as specified in paragraph "System Components". Fan and condenser motors shall have open dripproof enclosures.

2.7.1 Air-Cooled Condenser

Unit shall be rated in accordance with ARI 460 and conform to the requirements of UL 1995. Unit shall be factory fabricated, tested, packaged, and self-contained. Unit shall be complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary appurtenances.

2.7.1.1 Connections

Interconnecting refrigeration piping, electrical power, and control wiring between the condensing unit and the indoor unit shall be provided as required and as indicated. Electrical and refrigeration piping terminal connections between condensing unit and evaporator units shall be provided.

2.7.1.2 NOT USED

2.7.1.3 Condensing Coil

Coils shall have copper or aluminum tubes of 10 mm (3/8 inch) minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with a minimum 0.076 mm (3 mil) thick phenolic or vinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.7.1.4 Unit Controls

The control system shall be complete with required accessories for regulating condenser pressure by fan cycling, solid-state variable fan speed, modulating condenser coil or fan dampers, flooding the condenser, or a combination of the above. Unit mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1 or 3A enclosures. Controls shall include control transformer, fan motor starters, solid-state speed control, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

2.8 NOT USED

2.9 NOT USED

2.10 UNITARY EQUIPMENT COMPONENTS

2.10.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of

less than or equal to 0.05. Contractor shall provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the system performance testing period. Following the satisfactory completion of the performance testing, the oil shall be drained and replaced with a second charge. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

2.10.2 NOT USED

2.10.3 Primary/Supplemental Heating

2.10.3.1 NOT USED

2.10.3.2 NOT USED

2.10.3.3 Electric Heating Coil

Coil shall be an electric duct heater in accordance with UL 1995 and NFPA 70. Coil shall be unit-mounted. Coil shall be of the nickel chromium resistor, single stage, strip or nickel chromium resistor, single stage, strip or stainless steel, fin tubular type. Coil shall be provided with a built-in or surface-mounted high-limit thermostat interlocked electrically so that the coil cannot be energized unless the fan is energized. Coil casing and support brackets shall be of galvanized steel or aluminum. Coil shall be mounted to eliminate noise from expansion and contraction and be completely accessible for service.

2.11 NOT USED

2.12 FABRICATION

2.12.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 3 mm on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.12.2 Factory Applied Insulation

Refrigeration equipment shall be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation shall be

provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

2.13 SUPPLEMENTAL COMPONENTS/SERVICES

2.13.1 NOT USED

2.13.2 Refrigerant Piping

Refrigerant piping for split-system unitary equipment shall be provided and installed in accordance with Section 15182 REFRIGERANT PIPING.

2.13.3 NOT USED

2.13.4 Ductwork

Ductwork shall be provided and installed in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPV VIII Div 1 and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX.

3.1.1 NOT USED

3.1.2 NOT USED

3.1.3 Field Applied Insulation

Field applied insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein..

3.1.4 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900

PAINTING, GENERAL.

3.2 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS.

3.3 REFRIGERANT TESTS, CHARGING, AND START-UP

Split-system refrigerant piping systems shall be tested and charged as specified in Section 15182 REFRIGERANT PIPING. Packaged refrigerant systems which are factory charged shall be checked for refrigerant and oil capacity to verify proper refrigerant levels per manufacturer's recommendations. Following charging, packaged systems shall be tested for leaks with a halide torch or an electronic leak detector.

3.3.1 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.3.2 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 85 g (3 ounces) of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.4 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as

directed. Tests shall cover a period of not less than 4 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Field tests shall be coordinated with Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.5 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

SECTION 15895A

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 350	(1986) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 440	(1998) Room Fan-Coil and Unit Ventilator
ARI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1999) Laboratory Methods of Testing Fans for Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCAITION (ABMA)

AFBMA Std 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
AFBMA Std 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 106	(1999e1) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123/A 123M	(2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(2001) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999el) Ductile Iron Castings
ASTM A 733	(1999) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 1071	(1998) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 1384	(1997a) Corrosion Test for Engine Coolants in Glassware
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive

	Environments
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM D 520	(2000) Zinc Dust Pigment
ASTM E 437	(1992; R 1997) Industrial Wire Cloth and Screens (Square Opening Series)
ASTM F 1199	(1988; R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 1998) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 68	(1986) Laboratory Method of Testing In-Duct Sound Power Measurement Procedures for Fans
ASHRAE 70	(1991) Method of Testing for Rating the Performance of Air Outlets and Inlets

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code: Section IX Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves,

	Flanged and Threaded Ends
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA MG 1	(1998) Motors and Generators
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems
NFPA 96	(1998) Ventilation Control and Fire Protection of Commercial Cooking Equipment
SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)	
SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Install Fire Damp HVAC	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
U.S. GENERAL SERVICES ADMINISTRATION (GSA)	
CID A-A-1419	(Rev D; Canc. Notice 1) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable)
UNDERWRITERS LABORATORIES (UL)	
UL 181	(1996; Rev Dec 1998) Factory-Made Air Ducts and Air Connectors
UL 1995	(1995; Rev thru Aug 1999) Heating and Cooling Equipment
UL 214	(1997) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1999) Fire Dampers
UL 586	(1996; Rev thru Aug 1999) High-Efficiency, Particulate, Air Filter Units
UL 900	(1994; Rev thru Nov 1999) Test Performance of Air Filter Units
UL 94	(1996; Rev thru Jul 1998) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL Bld Mat Dir	(1999) Building Materials Directory

UL Fire Resist Dir (1999) Fire Resistance Directory (2 Vol.)

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G, RE
Installation; G, RE

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Drawing shall be signed by a professional engineer.

SD-03 Product Data

Components and Equipment; G, RE

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

a. Piping Components

b. Ductwork Components

c. Air Systems Equipment

d. Air Handling Units

e. Terminal Units

Test Procedures

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

System Diagrams; G, RE

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

Similar Services

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Welding Joints

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

Testing, Adjusting and Balancing

Proposed test schedules for hydrostatic test of piping, ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

Field Training

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

SD-06 Test Reports

Performance Tests

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

SD-07 Certificates

Bolts

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 PIPING COMPONENTS

2.5.1 Steel Pipe

Steel pipe shall conform to ASTM A 53/A 53M, Schedule 40, Grade A or B, Type E or S.

2.5.2 Joints and Fittings For Steel Pipe

Joints shall be welded, flanged, threaded, or grooved as indicated. If not otherwise indicated, piping 25 mm (1 inch) and smaller shall be threaded; piping larger than 25 mm (1 inch) and smaller than 80 mm (3 inches) shall be either threaded, grooved, or welded; and piping 80 mm (3 inches) and larger shall be grooved, welded, or flanged. Rigid grooved mechanical joints and fittings may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 110 degrees C. Flexible grooved joints shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting according to MSS SP-25.

2.5.2.1 Welded Joints and Fittings

Welded fittings shall conform to ASTM A 234/A 234M, and shall be identified with the appropriate grade and marking symbol. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11.

2.5.2.2 Flanged Joints and Fittings

Flanges shall conform to ASTM A 181/A 181M and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material according to ASME B16.21, 2.0 mm thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength

material conforming to ASTM A 193/A 193M.

2.5.2.3 Threaded Joints and Fittings

Threads shall conform to ASME B1.20.1. Unions shall conform to ASME B16.39, Class 150. Nipples shall conform to ASTM A 733. Malleable iron fittings shall conform to ASME B16.3, type as required to match piping.

2.5.2.4 Dielectric Unions and Flanges

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.5.2.5 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 862 kPa (125 psig) service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming to ASTM A 106, Grade B or ASTM A 53/A 53M. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 110 degrees C or Grade No. M3BA610A15B44Z for circulating medium up to 93 degrees C. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.5.3 Copper Tube

Copper tube shall conform to ASTM B 88, and ASTM B 88M, Type K or L.

2.5.4 Joints and Fittings For Copper Tube

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M . Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Grooved fittings and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C . Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.5.5 Valves

Valves shall be Class 125 and shall be suitable for the intended application. Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 3 meters or higher above the floor. Valves in sizes larger than 25 mm (1 inch) and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.5.5.1 Gate Valves

Gate valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with rising stem and threaded, solder, or flanged ends. Gate valves 80 mm (3 inches) and larger shall conform to MSS SP-70 and shall be cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.5.5.2 Globe Valves

Globe valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 80 mm (3 inches) and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.3 Check Valves

Check valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 80 mm (3 inches) and larger shall conform to MSS SP-71and shall be cast iron with bronze trim and flanged or threaded ends.

2.5.5.4 Angle Valves

Angle valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Angle valves 80 mm (3 inches) and larger shall conform to MSS SP-85and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.5 Ball Valves

Ball valves 15 mm (1/2 inch) and larger shall conform to MSS SP-72 or MSS SP-110, and shall be ductile iron or bronze with threaded, soldered, or flanged ends.

2.5.5.6 Butterfly Valves

Butterfly valves shall be MSS SP-68 lug wafer type, and shall be bubble-tight at 1.03 MPa, and suitable for dead-end service. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than

200 mm (8 inches) shall have throttling handles with a minimum of seven locking positions. Valves 200 mm (8 inches) and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.5.5.7 Balancing Valves

Balancing valves 50 mm (2 inches) or smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valves 25 mm or larger may be all iron with threaded or flanged ends. The valves shall have a square head or similar device and an indicator arc and shall be designed for 120 degrees C. Iron valves shall be lubricated, nonlubricated, or tetrafluoroethylene resin-coated plug valves. In lieu of plug valves, ball valves may be used. In lieu of balancing valves specified, automatic flow control valves may be provided to maintain constant flow, and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 862 kPa (125 psig) or 150 percent of the system operating pressure, whichever is the greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be appropriately increased. Where flow readings are provided by remote or portable meters, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter furnished with accessory kit as recommended by the automatic valve manufacturer shall be provided. Automatic flow control valve specified may be substituted for venturi tubes or orifice plate flow measuring devices.

2.5.5.8 Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for pressure rating of piping system and furnished with threaded plugs or caps. Automatic air vents shall be float type, cast iron, stainless steel, or forged steel construction, suitable for pressure rating of piping system.

2.5.6 Strainers

Strainer shall be in accordance with ASTM F 1199 or ASTM F 1200, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. The strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 0.8 mm (22 gauge) corrosion-resistant steel, with perforations to provide a net free area through the basket of at least 3.3 times that of the entering pipe. The flow shall be into the screen and out

through the perforations.

2.5.6.1 Strainer Openings

For Pipe Size	Opening Size	
Up to 50 mm (2")	.838 mm	(.033")
65 mm to 100 mm (2 1/2" - 4")	1.575 mm	(.062")
125 mm up (5" up)	3.175 mm	(.125")

2.5.7 Chilled Water System Accessories

Chilled water system accessories such as pumps, combination strainer and suction diffusers, and expansion tanks shall be as specified in Section 15620A LIQUID CHILLERS 15181A CHILLED AND CONDENSER WATER PIPING AND ACCESSORIES.

2.5.8 Water Heating System Accessories

Water heating accessories such as expansion tanks and steam traps shall be as specified in Section 15569A WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH.

2.5.9 Glycol

The glycol shall be tested according to ASTM D 1384 and shall cause less than 0.0125 mm penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicon based inhibitors shall not be used. The solution shall be compatible with all wetted items within the system.

2.5.10 Backflow Preventers

Backflow preventers shall be according to Section 15400A PLUMBING, GENERAL PURPOSE.

2.5.11 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 862 kPa (125 psi) or 1034 kPa (150 psi) service as appropriate for the static head plus the system head, and 120 degrees C, 110 degrees C for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.5.12 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 85 mm in diameter and shall have a range from 0 kPa to approximately 1.5 times the maximum system working pressure.

2.5.13 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 225 mm (9 inch) scale, and shall have rigid stems with straight, angular, or inclined pattern. Mercury shall not be used in thermometers.

2.5.14 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or setscrews.

2.5.15 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.5.16 NOT USED

2.5.17 Insulation

Shop and field applied insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.5.18 Condensate Drain Lines

Condensate drainage shall be provided for each item of equipment that generates condensate as specified for drain, waste, and vent piping systems in Section 15400A PLUMBING, GENERAL PURPOSE.

2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415A ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 745 W and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized

for motors rated 7.45 kW (10 hp) or less. Adjustable frequency drives shall be used for larger motors.

2.7 CONTROLS

Controls shall be provided as specified in Section 15951A DIRECT DIGITAL CONTROL FOR HVAC.

2.8 DUCTWORK COMPONENTS

2.8.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA HVAC Duct Const Stds unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 125, 250, and 500 Pa (1/2, 1, and 2 inch w.g.) ductwork shall meet the requirements of Seal Class C. Class 750 through 2500 Pa (3 through 10 inch) shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA HVAC Duct Const Stds. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 50 mm band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.8.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.8.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181and shall be rated for positive or negative working pressure of 3.75 kPa (15 inches water gauge) at 177 degrees C (350 degrees F) when duct is aluminum, and 343 degrees C (650 degrees F).

2.8.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runout length shall be as shown on the drawings, but shall in no case exceed 1.83 m (6 ft.) Runouts shall be preinsulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulated material and vapor barrier shall conform to the requirements of Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

2.8.1.4 General Service Duct Connectors

A flexible duct connector approximately 150 mm in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.8.2 NOT USED

2.8.3 Ductwork Accessories

2.8.3.1 Duct Access Doors

Access doors shall be provided in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA HVAC Duct Const Stds. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 375 x 450 mm, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 600 x 600 mm or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.8.3.2 Fire Dampers

Fire dampers shall be 1-1/2 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. A positive pressure relief door shall be provided upstream of fire dampers which are provided in the supply air and exhaust ducts. A negative pressure relief door shall be provided downstream of fire dampers which are provided in the return air ducts. The size and pressure relief rating of

the relief doors shall be in accordance with the manufacturer's recommendations. The pressure relief door may be a combined pressure relief and access door unit if it is specifically listed by the manufacturer as such. A pressure relief door shall be provided upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then this pressure relief damper shall be factory insulated. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL Fire Resist Dir. Fire dampers shall be curtain type with damper blades out of the air stream. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.8.3.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 5 mm (3/16 inch) rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 200 mm (8 inches). Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 300 mm. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

2.8.3.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections may be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90

degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

2.8.4 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.8.4.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 375 mm in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 375 mm in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 1.0 mm (20 gauge) galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53/A 53M, Schedule 20 shall be used. Sleeve shall provide 25 mm clearance between the duct and the sleeve or 25 mm clearance between the insulation and the sleeve for insulated ducts.

2.8.4.2 Framed Prepared Openings

Openings shall have 25 mm clearance between the duct and the opening or 25 mm clearance between the insulation and the opening for insulated ducts.

2.8.4.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 100 mm wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 375 mm in diameter or less shall be fabricated from 1.0 mm (20 gauge) galvanized steel. Collars for round ducts larger than 375 mm and square,

and rectangular ducts shall be fabricated from 1.3 mm (18 gauge) galvanized steel. Collars shall be installed with fasteners on maximum 150 mm centers, except that not less than 4 fasteners shall be used.

2.8.5 NOT USED

2.8.6 NOT USED

2.8.7 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 0.25 m/s (50 fpm) in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 2 m above the floor, they shall be protected by a grille or screen according to NFPA 90A.

2.8.7.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers. Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

2.8.7.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 150 mm below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 150 mm above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

2.8.8 Louvers

Louvers for installation in exterior walls which are associated with the air supply and distribution system shall be as specified in Section 10201 METAL WALL LOUVERS.

2.8.9 Air Vents, Penthouses, and Goosenecks

Air vents, penthouses, and goosenecks shall be fabricated from galvanized steel sheets with galvanized structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA HVAC Duct Const Stds. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Air vents, penthouses, and goosenecks shall be provided with bird screen.

2.8.10 Bird Screens and Frames

Bird screens shall conform to ASTM E 437, No. 2 mesh, aluminum or stainless steel. Aluminum screens shall be rated "medium-light". Stainless steel screens shall be rated "light". Frames shall be removable type, or stainless steel or extruded aluminum.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 11 kW (15 hp) and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.9.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly

constructed, accurately balanced both statically and dynamically. Fan blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 750 mm (30 inches). Fan blades for wheels over 750 mm (30 inches) in diameter shall be backward-inclined or airfoil design. Fan wheels over 900 mm (36 inches) in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 900 mm (36 inches) or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have open dripproof enclosures. Motor starters shall be magnetic across-the-line type with general-purpose enclosure.

2.9.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing. Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Motors shall have open dripproof enclosure, unless called out on drawing to be explosion-proof. Motor starters shall be magnetic across-the-line with general-purpose or explosion-proof enclosures as indicated on drawings. Provide inlet guard where there is no inlet ductwork. Provide with outlet flange for duct connection, and spring hanging isolators and brackets. Explosion-proof fans shall be provided with aluminum rub ring, housing and motor cover.

2.9.1.3 NOT USED

2.9.1.4 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 600 mm (24 inches) diameter shall be direct or V-belt driven and fans with wheels 600 mm (24 inches) diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Motor enclosure shall be dripproof type. Motor operated backdraft dampers shall be provided.

2.9.1.5 Centrifugal Upblast Fan

Centrifugal upblast fan shall be roof mounted, belt-driven, vertical discharge type. Housing shall be heavy gauge aluminum. Fan wheel shall be of the backward inclined, centrifugal type, constructed of aluminum and statically and dynamically balanced. Construction shall include a built-in grease drain. Motors shall be isolated from airstream and permanently lubricated, heavy-duty, ball bearing type. Fan shaft shall be ground and polished steel. Adjustable sheaves. Drives sized for 150% of driven horsepower. The entire fan and motor assembly shall be mounted on vibration isolators. Fans shall bear AMCA certified ratings seals.

2.9.1.6 NOT USED

2.9.1.7 NOT USED

2.9.1.8 NOT USED

2.9.1.9 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be U.L. listed.

2.9.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and copper fins mechanically bonded or soldered to the tubes. Copper tube wall thickness shall be a minimum of 0.508 mm (0.020 inches). Aluminum fins shall be 0.14 mm (0.0055 inch) minimum thickness. Casing and tube support sheets shall be not lighter than 1.6 mm (16 gauge) galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 2.76 MPa (400 psi) air pressure and shall be suitable for 1.38 MPa (200 psi) working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

2.9.2.1 NOT USED

2.9.2.2 Water Coils

Water coils shall be installed with a pitch of not less than 10 mm per meter of the tube length toward the drain end. Headers shall be constructed of cast iron, welded steel or copper. Each coil shall be provided with a plugged vent and drain connection extending through the unit casing.

2.9.3 Air Filters

Air filters shall be listed according to requirements of UL 900, except

high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.9.3.1 Rigid Filters

Rigid filter segment shall accommodate 50 mm (2 inch) depth prefilters and 305 mm (12 inch) depth final filters. Filter frames shall be provided with neoprene gasketing on the leaving air side of the filter for pressure sealing assembly. Filter frames shall be galvanized steel and shall be integral to unit. Prefilter shall have an average efficiency of 25-30 percent when tested according to ASHRAE 52.1. Initial resistance at 2.54 m/s (500 feet per minute) shall not exceed 9 mm water gauge. Final filters shall have an average efficiency of 60-65 percent when tested according to ASHRAE 52-76. Filter media shall be listed as Class 2 under UL Standard 900.

2.9.3.2 NOT USED

2.9.3.3 NOT USED

2.9.3.4 NOT USED

2.9.3.5 NOT USED

2.9.3.6 NOT USED

2.9.3.7 NOT USED

2.9.3.8 Range and Griddle Hood Service

Filter shall be sectional, permanent, washable, all metallic media type, nominal 50 mm (2 inches) thick, with suitable metal frames, designed for extraction of grease from grease-laden air.

2.9.3.9 Holding Frames

Frames shall be fabricated from not lighter than 1.6 mm (16 gauge) sheet steel with rust-inhibitor coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.9.3.10 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 98 mm (3-7/8 inches) in diameter, shall have white dials with black figures, and graduations shall be graduated in 0.0025 kPa mm (0.01 inch of water), and shall have a minimum range of 0.25 kPa (1 inch of water) beyond the specified final resistance for the filter bank on which each gauge is applied. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure tips with integral compression fittings, two molded plastic vent valves,

two 1.5 m (5 foot) minimum lengths of 6.35 mm (1/4 inch) diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 NOT USED

2.10.2 Factory-Fabricated Air Handling Units

Units shall be single-zone draw-through type as indicated. Units shall include fans, coils, airtight insulated casing, prefilters, secondary filter sections, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, mixing box vibration-isolators, and appurtenances required for specified operation. Vibration isolators shall be as indicated. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

2.10.2.1 Casings

Casing sections shall be 2 inch double wall type constructed of a minimum 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish according to paragraph FACTORY PAINTING. Inner casing of double-wall units shall be minimum 1.0 mm (20 gauge) solid galvanized steel. Casing shall be designed and constructed with an integral structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 1.3 mm (18 gauge) outer and 1.0 mm (20 gauge) inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 300 mm wide by 300 mm high. Access doors shall be minimum 600 mm wide and shall be the full height of the unit casing or a minimum of 1800 mm, whichever is less. Access Sections shall be according to paragraph AIR HANDLING UNITS. Drain pan shall be double-bottom type constructed of 16 gauge stainless steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Each casing section handling conditioned air shall be insulated with not less than 25 mm (1 inch) thick, 24 kg per cubic meter (1-1/2 pound density) coated fibrous glass material having a thermal conductivity not greater than 0.033 W/m-K (0.23 Btu/hr-sf-F). Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Foam-type insulation is not acceptable. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors and casings. Duct liner material, coating, and

adhesive shall conform to fire-hazard requirements specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 1071. A latched and hinged inspection door, shall be provided in the fan and coil sections.

2.10.2.2 Heating and Cooling Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

2.10.2.3 NOT USED

2.10.2.4 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.2.5 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Motor sheaves shall be variable pitch for 20 kW and below and fixed pitch above 20 kW as defined by ARI Guideline D. Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have open splashproof enclosures. Motor starters shall be magnetic across-the-line type with general-purpose enclosure. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300 or ASHRAE 68.

2.10.2.6 Access Sections and Filter/Mixing Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter/mixing boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to minimize air stratification and to promote thorough mixing of the air streams.

2.10.2.7 NOT USED

2.10.2.8 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.11 TERMINAL UNITS

2.11.1 Room Fan-Coil Units

Base units shall include galvanized coil casing, coil assembly drain pan, air filter, fans, motor, fan drive, and motor switch, plus an enclosure for cabinet models and casing for concealed models. Sound power levels shall be as indicated. Sound power level data or values for these units shall be obtained according to test procedures based on ARI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models will be acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Automatic valves and controls shall be provided as specified in paragraph CONTROLS. Each unit shall be fastened securely to the building structure. Capacity of the units shall be as indicated. Room fan-coil units shall be certified as complying with ARI 440, and shall meet the requirements of UL 1995.

2.11.1.1 Enclosures

Enclosures shall be fabricated of not lighter than 1.3 mm (18 gauge) steel, reinforced and braced. Front panels of enclosures shall be removable and provided with 13 mm (1/2 inch) thick dual density fibrous glass insulation. The exposed side shall be high density, erosion-proof material suitable for use in air streams with velocities up to 23 m/s (4,500 fpm). Plastic return grilles are acceptable provided the plastic material is certified by the manufacturer to be classified as flame resistant according to UL 94 and the material shall comply with the heat deflection criteria specified in UL 1995. Ferrous metal surfaces shall be galvanized or factory finished with corrosion resistant enamel. Access doors or removable panels shall be provided for piping and control compartments. Duct discharge collar shall be provided for concealed models. Enclosures shall have easy access for filter replacement.

2.11.1.2 Fans

Fans shall be galvanized steel or aluminum, multiblade, centrifugal type. In lieu of metal, fans and scrolls may be non-metallic materials of suitably reinforced compounds. Fans shall be dynamically and statically

balanced. Surfaces shall be smooth. Assemblies shall be accessible for maintenance. Disassembly and re-assembly shall be by means of mechanical fastening devices and not by epoxies or cements.

2.11.1.3 Coils

Coils shall be constructed of not less than 10 mm (3/8 inch) outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Coils shall be provided with not less than 12 mm (1/2 inch) outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Coils shall be tested hydrostatically at 2000 kPa (300 psi) or under water at 1700 kPa (250 psi) air pressure and suitable for 1400 kPa (200 psi) working pressure. Provisions shall be made for coil removal.

2.11.1.4 Drain Pans

Drain and drip pans shall be sized and located to collect all water condensed on and dripping from any item within the unit enclosure or casing. Drain pans shall be constructed of not lighter than 0.9 mm (21 gauge) steel, galvanized after fabrication, thermally insulated to prevent condensation. Insulation shall have a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and shall be of a waterproof type or coated with a waterproofing material. In lieu of the above, drain pans may be constructed of die-formed 0.85 mm (22 gauge) steel, formed from a single sheet, galvanized after fabrication, insulated and coated as specified for the 0.9 mm (21 gauge) material or of die-formed 0.9 mm (21 gauge) type 304 stainless steel, insulated as specified above. Drain pans shall be pitched to drain. Minimum 20 mm (3/4 inch) NPT or 15 mm (5/8 inch) OD drain connection shall be provided in drain pan. Auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages, may be plastic; if metal, the auxiliary pans shall comply with the requirements specified above. Insulation at control and piping connections thereto shall extend 25 mm minimum over the auxiliary drain pan.

2.11.1.5 NOT USED

2.11.1.6 Filters

Filters shall be of the fiberglass disposable type, 25 mm (1 inch) thick, conforming to CID A-A-1419. Filters in each unit shall be removable without the use of tools.

2.11.1.7 Motors

Motors shall be of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Motor switch shall be two or three speeds and off, manually operated, and shall be mounted on an identified plate inside the unit below or behind an access door. In lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent may be provided.

Motors shall have permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity shall not exceed the following values:

Free Discharge Motors

Unit Capacity (LS)	Maximum Power Consumption (Watts)		
	115V	230V	277V
94	70	110	90
142	100	110	110
189	170	150	150
283	180	210	220
378	240	240	230
472	310	250	270
566	440	400	440

High Static Motors

Unit Capacity (L/S)	Maximum Power Consumption (Watts)
94	145
142	145
189	210
283	320
378	320
472	530
566	530

2.11.1.8 Isolators

Provide restrained spring type isolators, matched by factory to the unit weight, for each suspended fan coil. Provide flexible ductwork connectors.

2.11.2 Kitchen Makeup Air Unit

Provide a complete fan package with tempered supply air and an upblast centrifugal exhaust fan, all mounted on the same roof curb. Unit shall meet NFPA 96. Filtered makeup air unit shall have belt driven double width, double inlet, forward curved fans. The entire fan and motor shall be mounted on vibration isolators. Motors shall be permanently lubricated, heavy duty, ball bearing type. The fan shaft shall be ground and polished steel mounted on heavy-duty ball bearings. Fan wheels shall be of the forward curved type, statically and dynamically balanced. Housing shall be galvanized steel, lined with fiberglass insulation. Filters shall be 50 mm throwaway type. Upblast fan shall be as specified elsewhere in this specification section. Direct fired gas heater shall utilize natural gas and have a 100% efficiency. Burners shall be constructed of cast iron pipe with two perforated stainless steel combustion baffles. Safeties shall include but not be limited to; high limit control, air pressure switch, a

fan interlock to prevent heater ignition when the fan is not operating, main and pilot gas valves to regulate gas flow, a modulating gas valve and with duct sensor and a flame rod for heater shutdown if pilot is not sensed within ten seconds after activation. Provide galvanized weather hood with steel mesh bird screen. Provide with prewired control center housing magnetic starters, control transformers, integral disconnect, fuse blocks and any other required component for power connection. Provide with prefabricated roof curb that is lined with fiberglass insulation, equipment supports, ductwork adaptor to curb, and a motorized damper constructed of galvanized steel with aluminum blades.

2.12 NOT USED

2.13 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123/A 123M or ASTM A 924/A 924M shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatized and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 3 mm. Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Piping

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall be not less than 2 mm in 1 m. Reducing fittings shall be used for changes in pipe

sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 65 mm (2-1/2 inches) or less in diameter, and with flanges for pipe 80 mm (3 inches) and larger. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric unions or flanges. All piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits shall be welded.

3.1.1.1 Joints

a. Threaded Joints: Threaded joints shall be made with tapered threads and made tight with a stiff mixture of graphite and oil or polytetrafluoroethylene tape or equivalent thread joint compound or material, applied to the male threads only.

b. Soldered Joints: Joints in copper tubing shall be cut square with ends reamed, and all filings and dust wiped from interior of pipe. Joints shall be soldered with 95/5 solder or brazed with silver solder applied and drawn through the full fitting length. Care shall be taken to prevent annealing of tube or fittings when making connections. Joints 65 mm (2-1/2 inches) and larger shall be made with heat uniformly around the entire circumference of the joint with a multi-flame torch. Connections in floor slabs shall be brazed. Excess solder shall be wiped from joint before solder hardens. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

c. Welded Joints: Welding shall be according to qualified procedures using qualified welders and welding operators. Procedures and welders shall be qualified according to ASME BPVC SEC IX. Welding procedures qualified by others and welders and welding operators qualified by another operator may be permitted by ASME B31.1. Structural members shall be welded according to Section 05090A WELDING, STRUCTURAL. All welds shall be permanently identified by imprinting the welder's or welding operator's assigned symbol adjacent to the weld. Welded joints shall be fusion welded unless otherwise required. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. Electrodes shall be stored and dried according to AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.1.2 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.1.1.3 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.1.2 Supports

3.1.2.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.2.2 NOT USED

3.1.2.3 Pipe Hangers, Inserts and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Types 5, 12, and 26 shall not be used.

a. Hangers: Type 3 shall not be used on insulated piping.

b. Inserts: Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.

c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

d. Angle Attachments: Type 20 attachments used on angles and

channels shall be furnished with an added malleable-iron heel plate or adapter.

e. Hangers: Type 24 may be used only on trapeze hanger systems or on fabricated frames.

f. Type 39 saddles shall be used on all insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is above 15.5 degrees C. Type 39 saddles shall be welded to the pipe.

g. Type 40 shields shall:

(1) be used on all insulated pipes less than 100 mm (4 inches).

(2) be used on all insulated pipes 100 mm (4 inches) and larger when the temperature of the medium is 15.5 degrees C or less.

(3) have a high density insert for pipe 50 mm (2 inches) and larger, and for smaller pipe when the insulation shows signs of being visibly compressed, or when the insulation or jacket shows visible signs of distortion at or near the type 40 shield. High density inserts shall have a density of 144 kg/cubic meter (9 pcf) or greater.

h. Horizontal Pipe Supports: Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm (1 foot) from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 220 N (50 pounds) shall have the excess hanger loads suspended from panel points.

i. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 5 m , not more than 2.4 m from end of risers, and at vent terminations.

j. Pipe Guides: Type 35 guides using steel reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

k. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 100 mm (4 inches) and larger with medium 15.5 degrees C or greater, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 100 mm (4 inches), a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

l. Insulated Pipe: Insulation on horizontal pipe shall be continuous

through hangers for hot and cold piping. Other requirements on insulated pipe are specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.1.4 Pipe Sleeves

Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated, sleeves shall provide a minimum of 6 mm all-around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve, in non-fire rated walls, shall be sealed as indicated and specified in Section 07900A JOINT SEALING.

3.1.4.1 Roof and Floor Sleeves

Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 200 mm from the pipe and shall be set over the roof or floor membrane in a troweled coating of bituminous cement. Unless otherwise shown, the flashing sleeve shall extend up the pipe a minimum of 50 mm above highest floor level or a minimum of 250 mm above the roof. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 250 mm (10 inches) in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess. In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be

loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.1.4.2 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840A FIRESTOPPING.

3.1.4.3 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering.

3.1.5 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 50 mm plus 0.1 mm for each Pa, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.6 Pipe-Alignment Guides

Pipe-alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 1.5 m on each side of each expansion joint, and in lines 100 mm (4 inches) or smaller not more than 600 mm on each side of the joint.

3.1.7 Air Vents and Drains

3.1.7.1 Vents

Air vents shall be provided at high points, on water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7.2 Drains

Drains shall be provided at low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment such as pumps, heaters, heating or cooling coils, and other similar items, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purposes. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.9 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 150 mm (6 inch) concrete pads or curbs doweled in place. Concrete foundations for circulating pumps shall be heavy enough to minimize the intensity of the vibrations transmitted to the piping and the surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, a concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. The concrete foundation or concrete pedestal block shall be of a mass not less than three times the weight of the components to be supported. Lines connected to the pump mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.10 Access Panels

Access panels shall be provided for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METAL.

3.1.11 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.12 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07840A FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall

be packed as specified in Section 07900A JOINT SEALING.

3.1.13 Metal Ductwork

Installation shall be according to SMACNA HVAC Duct Const Stds unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC Duct Const Stds, unless otherwise specified. Friction beam clamps indicated in SMACNA HVAC Duct Const Stds shall not be used. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.14 NOT USED

3.1.15 NOT USED

3.1.16 Kitchen Exhaust Ductwork

3.1.16.1 Ducts Conveying Smoke and Grease Laden Vapors

Ducts conveying smoke and grease laden vapors shall conform to requirements of NFPA 96. Seams, joints, penetrations, and duct-to-hood collar connections shall have a liquid tight continuous external weld. Duct material shall be minimum 1.3 mm (18 gauge), Type 304L or 316L, stainless steel.

3.1.16.2 Exposed Ductwork

Exposed ductwork shall be fabricated from minimum 1.3 mm (18 gauge), Type 304L or 316L, stainless steel with continuously welded joints and seams. Ducts shall be pitched to drain at hoods and low points indicated. Surface finish shall match hoods.

3.1.16.3 Concealed Ducts Conveying Moisture Laden Air

Concealed ducts conveying moisture laden air shall be fabricated from minimum 1.3 mm (18 gauge), Type 300 series, stainless steel or 1.6 mm (16 gauge), galvanized steel. Joints shall be continuously welded, brazed, or soldered to be liquid tight. Duct shall be pitched to drain at points indicated. Transitions to other metals shall be liquid tight, companion angle bolted and gasketed.

3.1.17 NOT USED

3.1.18 NOT USED

3.1.19 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air reaches the

conditioning unit.

3.1.20 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.21 NOT USED

3.1.22 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING AND COLOR CODE MARKING

Finish painting of items only primed at the factory, surfaces not specifically noted otherwise, and color code marking for piping shall be as specified in Section 09900 PAINTS AND COATINGS.

3.3 PIPING HYDROSTATIC TEST

After cleaning, water piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Leaks shall be repaired and piping retested until test is successful. No loss of pressure will be allowed. Leaks shall be repaired by re-welding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before covering or concealing.

3.4 DUCTWORK SEALING AND LEAK TEST

3.4.1 Sealing

3.4.1.1 Duct Seams

Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards Metal and Flexible".

3.4.1.2 Pressure Class Less than 2-Inch WG

For pressure class less than 2-inch WG (500 pa), seal transverse joints (seal Class "C").

3.4.1.3 Externally Insulated Ducts

Seal externally insulated ducts before insulation installation.

3.4.2 Leak Test

3.4.2.1 Duct Pressure Classification

Not required for duct pressure classification 500 pa (2") and less.

3.4.2.2 Testing of Entire System

Where noted 750 pa (3") or higher, up to Class 2500 pa (10") - Test entire system so noted including fans, coils, filters, etc. Test procedure apparatus, and report shall conform to SMACNA Leakage Test Manual. Meet Leakage Class 3 for round duct and 6 for rectangular ducts at the duct pressure rating.

3.4.2.3 Ductwork Leak Test

Ductwork leak test shall be completed with satisfactory results prior to applying exterior duct insulation.

3.5 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of room fan-coil units ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.6 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.7 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 2 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Coincidental chart recordings shall be made at points indicated on the drawings for the duration of the time period and shall record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

3.8 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel and maintenance contractor personnel as designated by the Contracting Officer. Training shall be provided for a period of 24 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

SECTION 15940A

OVERHEAD VEHICLE TAILPIPE EXHAUST REMOVAL SYSTEM(S)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1999) Laboratory Methods of Testing Fans for Rating

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 193/A 193M	(2001a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2000a) Carbon Structural Steel
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 569/A 569M	(1998) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 32	(1996) Solder Metal
ASTM E 437	(1992; R 1997) Industrial Wire Cloth and Screens (Square Opening Series)

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Rnd Duct Const	(1977) Round Industrial Duct Construction Standards

1.2 GENERAL REQUIREMENTS

The Contractor shall construct, complete and operational,exhaust system(s) as specified herein. The exhaust system(s) shall provide adequate air exhaust quantities and velocities. All duct shall be properly sized for pressure loss and adequate velocity including locating intakes, ductwork size, layout, equipment and controls. Construction of the exhaust system(s) shall be based on the referenced publications, and other provisions as specified herein.

1.3 COORDINATION OF TRADES

Ductwork offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete exhaust system installation and to eliminate interference with other construction.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all ductwork, flexible connections and pipes shall either be capped or plugged until installed.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Exhaust System Drawings
Exhaust System Installation

Three copies of the Exhaust System Drawings, no later than 21 days prior to the start of exhaust system installation. Detail drawings consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall also contain complete duct, wiring, and schematic diagrams and any other details to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment in relation to other parts of the work including clearances required for maintenance and operation.

SD-03 Product Data

Exhaust System Related Submittals; G, RE

A list of the Exhaust System Related Submittals, no later than 7 days after the approval of the Exhaust System Specialist.

Ductwork Components; G, RE
Materials and Equipment; G, RE

Manufacturer's catalog data included with the Exhaust System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Spare Parts

Spare parts data shall be included for each different item of

material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

Field Instructions
Final Acceptance Tests

Proposed diagrams, instructions, and other sheets, concurrent with the Final Acceptance Test Procedures, Framed instructions under glass or in laminated plastic shall be posted where directed, including wiring and control diagrams showing the complete layout of the entire system. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

Proposed procedures for Final Acceptance Tests, no later than 14 days prior to the proposed start of the tests.

Proposed date and time to begin Final Acceptance Tests, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test.

On-site Training; G, RE

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Exhaust System Specialist; G, RE

The name and documentation of certification of the proposed Specialists, no later than 14 days after the Notice to Proceed.

SD-06 Test Reports

Final Acceptance Tests

Three copies of the completed Final Acceptance Tests Reports, no later that 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Exhaust System Specialist.

SD-07 Certificates

Inspection by Exhaust System Specialist

Concurrent with the Final Acceptance Test Report, certification by the Exhaust System Specialist that the exhaust system is installed in accordance with the contract requirements, including signed approval of the Final Acceptance Test Reports.

SD-10 Operation and Maintenance Data

Exhaust System
Operation and Maintenance Manuals

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to on-site training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.7 EXHAUST SYSTEM SPECIALIST

The Exhaust System Specialist shall perform work specified in this section. The Exhaust System Specialist shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Where an integrated, packaged exhaust system is furnished, all items will be the product of the system manufacturer. System component parts may be by other manufacturers. Equipment shall be supported by a service organization that is capable of responding to service calls within four hours.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 CONTROLS

Controls shall be provided as specified in Section 15951 DIRECT DIGITAL CONTROL FOR HVAC.

2.6 DUCTWORK COMPONENTS

2.6.1 General

Duct shall be constructed of galvanized sheets of the minimum gauge thickness for ducts as required in SMACNA Rnd Duct Const. Ducts shall be constructed and sealed in accordance with SMACNA Rnd Duct Const for a negative pressure of 750 Pa static pressure. Ducts, unless otherwise approved, shall be round with longitudinal lock seam and conform to the dimensions indicated. Ducts shall be straight and smooth on the inside with airtight joints. Where ducts with crimped ends are used to make up joints, the joints shall have crimp and bead. The bead shall provide a rigid stop for the mating open end to seat against. Steel spiral wound duct is not acceptable.

2.6.2 Fittings

Reducing fittings shall have a minimum of 1 mm increase in diameter per 8 mm in length. Elbows shall have a centerline radius of not less than 1-1/2 times the diameter. Branches shall stub into mains at main expansion points at an angle of not more than 30 degrees with the centerline of the main duct in the direction of air flow, unless otherwise indicated or approved. Where riser ducts with single or multiple inlets are indicated, the riser duct shall connect into the bottom of the main duct at an angle as specified for branches. Where flexible connections connect to the main duct, the duct branch takeoff or stub shall be braced with approved metal straps or members.

2.6.3 Cleanout

Cleanout shall be provided on the end of the main ductwork opposite the end of the fan suction connection. The cleanout opening shall be sized to the approximate inside area of the duct. Removable airtight caps or flange type covers of minimum gauge thickness as the main duct shall be provided. Other cleanout openings shall be provided where indicated.

2.6.4 Apparatus Connections

Where sheet metal connections are made to fan suction and discharge, or where ducts of dissimilar metals are connected, an approved noncombustible flexible connection approximately 150 mm wide shall be installed and

securely fastened by zinc-coated steel clinch-type draw bands for round ducts. For rectangular ducts the flexible connections locked to metal collars shall be installed using normal duct construction methods.

2.6.5 Duct Test Holes

Test holes with covers shall be provided where indicated, directed, or where necessary in ducts and plenums for using Pitot tubes for taking air measurements to balance the air systems.

2.6.6 Duct Sleeves and Framed Openings

Duct sleeves shall be provided for all round ducts 375 mm diameter or less passing through floors, walls, ceilings, or roofs. Sleeves in non-load bearing walls shall be fabricated of 1.0 mm (20 gauge) steel sheets conforming to ASTM A 924/A 924M. Sleeves in load-bearing walls shall be fabricated of standard-weight galvanized steel pipe conforming to ASTM A 53/A 53M. Round ducts larger than 375 mm diameter and all square and rectangular ducts passing through floors, walls, ceilings, or roofs shall be installed through framed openings. Structural steel members for framed openings shall conform to ASTM A 36/A 36M. Framed openings shall provide 25 mm clearance between the duct and the opening. Closure collars of galvanized steel not less than 100 mm wide shall be provided on each side of walls or floors where sleeves or framed openings are provided. Collars for round ducts 375 mm diameter or less shall be fabricated from 1.0 mm (20 gauge) galvanized steel. Collars for round, square or rectangular ducts with minimum dimension over 375 mm shall be fabricated from 1.2 mm (18 gauge) galvanized steel.

2.7 EXHAUST HOSE SYSTEM

2.7.1 Tailpipe Adapters

Adapters shall be of the tapered-cone type with spring clips or other suitable devices for exhaust pipe attachment. The adapter shall fit 150 mm nominal diameter exhaust pipe. Provide 2 adaptors to handle vehicles with dual exhaust systems.

2.7.2 Welding Fume Receptors

Welding fume receptors shall be constructed of not less than 1.0 mm (20 gauge) thick aluminum and shall be equipped with 13 mm mesh receptor screens; shall have swivel connections, and magnets on receptor base.

2.7.3 Flexible Exhaust Hose

Flexible exhaust hose shall be approved heat-resistant wire reinforced glass fiber and silicone tubing. Wye connectors shall be provided where shown. Flexible tubing inside diameter and length shall be as shown. The tubing shall be connected to the bottom of the ductwork. A flanged connection shall be provided where the flexible tubing and overhead ductwork are joined. The flanged connection shall consist of steel flanges not less than 200 mm (0.078 inch) thick, 3.175 mm (1/8 inch) gasket. The gasket shall be suitable for the system design temperature shown, in

accordance with ASME B16.21, full face or self-centering flat ring type. It shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). The flange shall be sized or designed to suit the hose as approved.

2.7.4 Exhaust Hose Suspension System

The exhaust hose suspension system shall suspend the flexible tubing overhead when not in use; allowing it to be lowered to the operating level, when required. The suspension system shall be furnished complete with cable, and operating mechanism. The suspension system shall be a hanging pendant switch to raise and lower the hose.

2.8 DAMPERS

Dampers shall be of the type indicated and installed where shown and at each individual tailpipe adapter. Dampers shall be of the circular disk type with quadrant locking device or blast gate type. Damper blades shall be not less than 1.6 mm (16 gauge) thickness of stainless steel. Blast gate dampers shall be two piece construction with adjustable sliding gate and setscrew.

2.9 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the following requirements.

2.9.1 Screen

ASTM E 437, type and class as required for the application.

2.9.2 Iron and Steel Sheets

2.9.2.1 Galvanized Iron and Steel

ASTM A 924/A 924M, Coating Designation G90.

2.9.2.2 Uncoated Steel

ASTM A 569/A 569M, condition, and type best suited to intended use.

2.9.2.3 Stainless Steel

ASTM A 167, Type 304.

2.9.3 Steel Structural Shapes

ASTM A 36/A 36M.

2.9.4 Solder Silver

AWS A5.8, brazing alloy; grade to suit application.

2.9.5 Solder

ASTM B 32, composition to suit application.

2.9.6 Bolts and Nuts

Bolts and nuts, except as required for high temperature exhaust applications, shall be in accordance with ASTM A 307. Bolts and nuts used for exhaust applications where the temperature of the bolt may rise above 200 degrees C or used as flange bolts in corrosion resistant material shall be in accordance with ASTM A 193/A 193M Class 2. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307 or ASTM A 193/A 193M as applicable.

2.10 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415A ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 745 W and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided.

2.11 AIR MOVING DEVICES (EXHAUST FAN EF-8)

2.11.1 General

Fans shall be tested and rated in accordance with the standards of AMCA 210, Type "D" Ducted Inlet, Ducted Outlet Configuration. Where V-belt drives are used, such drives shall be designed for not less than 150 percent of the connected driving capacity, and motor sheaves shall be adjustable to provide not less than an overall 20 percent speed variation. Sheaves shall be selected to drive the fan at such speed as to produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable rails or bases. Fans shall be provided with personnel screens or guards on both suction and supply ends except where ducts or dampers are connected to the fan. Fans and motors shall be provided with vibration isolation supports or mountings. Vibration isolation units shall be standard products with published load ratings, and shall be single rubber-in-shear, neoprene coated fiberglass, double rubber-in-shear springs, or springs under inertia base. Each fan shall be selected to produce the capacity required at the fan total pressure indicated. Standard AMCA arrangements shall be provided unless otherwise indicated and the rotation and discharge shall be as indicated. Fans shall have nonoverloading characteristics. Fan housing shall be constructed with not less than 1.5 mm (16 gauge) thickness of steel. Fan impellers shall be constructed to meet AMCA Spark Resistance "B" Classification and accurately balanced both statically and dynamically when installed in the assembled fan unit. Impeller and housing in the air

stream shall be coated with neoprene, epoxy, phenolic resins, or otherwise be suitable to resist the corrosive gases and temperatures produced. Fans shall be free of objectionable vibration or noise. Certified performance curves indicating that the fan supplied will operate in its most efficient operating range will be provided. In addition, "sound power" ratings shall be furnished with each fan. Fans indicated to be mounted on exterior of building shall be provided with weatherproof covers for the motor drive unit or other weatherproofing as recommended by the manufacturer. Each fan shall be selected to produce the capacity required at the fan total pressure indicated. Weather hoods, flashing, and bird screens shall be provided where indicated.

2.11.2 NOT USED

2.11.2.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades shall be backward-inclined design. These fans shall be suitable for the temperatures encountered. The fan shaft shall be provided with a heat slinger to dissipate heat buildup along the shaft. An access (service) door to facilitate maintenance shall be supplied with these fans. Fan wheels over 900 mm (36 inches) in diameter shall have overhung pulleys and a bearing on each side of the wheel. Indirect drive fan wheels 900 mm (36 inches) or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have open dripproof enclosures. Motor starters shall be magnetic across-the-line type with general-purpose enclosure. Provide with wall mounted suspension platform of heavy-duty, all welded construction.

2.12 FACTORY COATING

Equipment and component items, when fabricated from ferrous metal as defined by ASTM (or similar) standard, shall be factory finished with the manufacturers standard finish except that items located outside of building shall have weather-resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117.

PART 3 EXECUTION

3.1 EXHAUST SYSTEM RELATED SUBMITTALS

The Exhaust System Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Exhaust System Specialist when submitted to the Government.

3.2 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.3 INSPECTION BY EXHAUST SYSTEM SPECIALIST

The Exhaust System Specialist shall inspect the exhaust system periodically during the installation to assure that the system installed in accordance with the contract requirements. The Exhaust Specialist shall witness the preliminary and final tests, and shall sign the test results. The Exhaust System Specialist, after completion of the system inspections and successful Final Acceptance Test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 EXHAUST SYSTEM INSTALLATION

Welding and brazing shall conform to ASME BPVC SEC IX. Horizontal sections of the main duct shall be installed with the longitudinal lock seam on the top. Slip joints shall be sealed in accordance with SMACNA Rnd Duct Const. Main duct shall be attached to the structural members of the building as recommended by SMACNA Rnd Duct Const.

3.4.1 Building Surface Penetrations

Sleeves or framed openings shall be utilized where duct penetrates building surfaces. Penetrations shall be sealed, and fireproofed in accordance with Section 07840A FIRESTOPPING. The space between the sleeve or framed opening and the duct shall be packed with mineral wool or other approved material. Closure collars shall be installed around the duct on both sides of the penetrated surface. Collars shall fit tight against the building surfaces and snugly around the duct.

3.5 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.6 FINAL ACCEPTANCE TESTS

Each exhaust system and inlet shall be balanced to produce the indicated air quantities within 10 percent at the conditions shown. Control devices shall be set to control at the points indicated or directed. Bearings shall be lubricated, and the speed, direction or rotation of each fan shall be checked. The running current of each motor shall be checked. Upon

completion, and prior to acceptance of the installation, the exhaust system shall be tested at operating conditions with all hoses operating at the same time, to demonstrate satisfactory functional and operating efficiency. Operating tests shall cover a period of not less than 2 hours for each system, and all tests shall be conducted in the presence of the Contracting Officer. If tests do not demonstrate satisfactory operation of the exhaust system, deficiencies shall be corrected and retested. All instruments, facilities, and labor required to properly conduct the tests shall be provided by the Contractor. The electricity required for testing will be furnished by the Government.

3.7 ON-SITE TRAINING

The Contractor shall conduct a training course for the operating staff and preventive maintenance contractor personnel as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

-- End of Section --

SECTION 15951A

DIRECT DIGITAL CONTROL FOR HVAC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500	(11989; Rev994) Test Methods for Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 269	(1996) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM D 1693	(1997a) Environmental Stress-Cracking of Ethylene Plastics
ASTM D 635	(1997) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASME INTERNATIONAL (ASME)

ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA-232-F	(1991) Interface Between Data Technical Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 142	(1991) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ST 1	(1988) Specialty Transformers (Except General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 268A	(1998) Smoke Detectors for Duct Application
UL 508	(1993; Rev thru Oct 1997) Industrial Control Equipment
UL 555S	(1996) Leakage Rated Dampers for Use in Smoke Control Systems
UL 94	(1996; Rev thru Jul 1998) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 GENERAL REQUIREMENTS

The direct digital control (DDC) shall be a complete system suitable for the heating, ventilating and air-conditioning (HVAC) system.

1.2.1 Nameplates, Lens Caps, and Tags

Nameplates and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

1.2.2 Verification of Dimensions

After becoming familiar with all details of the work, the Contractor shall

verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.2.3 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

1.2.4 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from power-line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

1.2.5 Surge Protection for Transmitter and Control Wiring

DDC system control-panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

a. A 10-microsecond by 1,000-microsecond waveform with a peak voltage of 1,500 volts and a peak current of 60 amperes.

b. An eight microsecond by 20-microsecond waveform with a peak voltage of 1,000 volts and a peak current of 500 amperes.

1.2.6 System Overall Reliability Requirement

The system shall be configured and installed to yield a mean time between failure (MTBF) of at least 40,000 hours. Each DDC controller shall be designed, configured, installed and programmed to provide for stand alone operation with minimal performance degradation on failure of other system components to which it is connected or with which it communicates.

1.2.7 DDC System Network Accessibility

Where the systems to be controlled by the DDC system are located in multiple mechanical rooms, each mechanical room shall have at least one communication port for the portable workstation/tester. DDC controllers shall be located in the same room as the equipment being controlled or in an adjacent space which has direct access to the equipment room.

1.2.8 System Accuracy and Display

The system shall maintain an end-to-end accuracy for one year from sensor to operator's console display for the applications specified and shall display the value as specified. Each temperature shall be displayed and printed to nearest 0.05 degree C.

1.2.8.1 Space Temperature

Space temperature with a range of 10 to 30 degrees C plus or minus 0.5 degrees C for conditioned space; minus 1 to plus 55 degrees C plus or minus 0.5 degrees C for unconditioned space.

1.2.8.2 Duct Temperature

Duct temperature with a range of 5 to 60 degrees C plus or minus 1 degree C.

1.2.8.3 Outside Air Temperature

Outside air (OA) temperature with a range of minus 35 to plus 55 degrees C plus or minus 1 degree C; with a subrange of minus 1 to plus 40 degrees C plus or minus 0.5 degree C.

1.2.8.4 Water Temperature

Water temperature with a range of minus 1 to plus 40 degrees C plus or minus 0.5 degree C; the range of 40 to 120 degrees C plus or minus 1 degree C; and water temperatures for the purpose of performing energy calculations using differential temperatures to plus or minus 0.5 degree C using matched sensors.

1.2.8.5 High Temperature

High temperature with a range of 100 to 260 degrees C plus or minus 1 degree C.

1.2.8.6 Relative Humidity

Relative humidity, within a range of 20 to 80 percent, plus or minus 6.0 percent of range (display and print to nearest 1.0 percent).

1.2.8.7 Pressure

Pressure with a range for the specific application plus or minus 2.0 percent of range (display and print to nearest kPa.)

1.2.8.8 Flow

Flow with a range for the specific application plus or minus 3.0 percent of range, and flows for the purpose of thermal calculations to plus or minus 2.0 percent of actual flow (display and print to nearest unit, such as liters per second.

1.2.8.9 KWh and kW Demand

KWh and kW demand with a range for the specific application plus or minus 1.0 percent of reading (display and print to nearest kWh or kW).

1.2.8.10 Analog Value Input

An analog value input to the system's equipment via an AI with a maximum error of 0.50 percent of range, not including the sensor or transmitter error. This accuracy shall be maintained over the specified environmental conditions.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

HVAC Control System; G, RE

Drawings shall be on A1 (841 by 594 mm) sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and identifiers shown. Each control system element on a drawing shall have a unique identifier as shown. The HVAC Control System Drawings shall be delivered together as a complete submittal. Deviations must be approved by the Contracting Officer. Drawings shall be submitted along with Submittal SD-01, Data.

a. HVAC Control System Drawings shall include the following:

Sheet One: Drawing Index, HVAC Control System Legend.

Sheet Two: Valve Schedule, Damper Schedule.

Sheet Three: Compressed Air Station Schematic.

Sheet Four: Control System Schematic and Equipment Schedule.

Sheet Five: Sequence of Operation and Data Terminal Strip Layout.

Sheet Six: Control Loop Wiring Diagrams.

Sheet Seven: Motor Starter and Relay Wiring Diagram.

Sheet Eight: Communication Network and Block Diagram.

Sheet Nine: DDC Panel Installation and Block Diagram.

(Repeat Sheets Four through Seven for each AHU System.)

b. The HVAC Control System Drawing Index shall show the name and number of the building, military site, State or other similar designation, and Country. The Drawing Index shall list HVAC Control System Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. The HVAC

Control System Legend shall show generic symbols and the name of devices shown on the HVAC Control System Drawings.

c. The valve schedule shall include each valve's unique identifier, size, flow coefficient Kv, pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data. Valve schedules may be submitted in advance but shall be included in the complete submittal.

d. The damper schedule shall contain each damper's and each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The Damper Schedule shall include the maximum leakage rate at the operating static-pressure differential. The Damper Schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements. Damper schedules may be submitted in advance but shall be included in the complete submittal.

e. The HVAC control system schematics shall be in the form shown, and shall show all control and mechanical devices associated with the HVAC system. A system schematic drawing shall be submitted for each HVAC system.

f. The HVAC control system equipment Schedule shall be in the form shown. All devices shown on the drawings having unique identifiers shall be referenced in the equipment schedule. Information to be included in the equipment schedule shall be the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e., output range). An equipment schedule shall be submitted for each HVAC system.

g. The HVAC control system sequence of operation shall reflect the language and format of this specification, and shall refer to the devices by their unique identifiers as shown. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. Sequences of operation shall be submitted for each HVAC control system including each type of terminal unit control system.

h. The HVAC control system wiring diagrams shall be functional wiring diagrams which show the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged equipment control systems shall be identified back to the panel

board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown. Wiring diagrams shall be submitted for each HVAC control system.

SD-03 Product Data

Service Organizations; G, RE

Six copies of a list of service organizations qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

Equipment Compliance Booklet; G, RE

The HVAC Control System Equipment Compliance Booklet (ECB) shall be in booklet form and indexed, with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers. Devices and components which do not have unique identifiers shall follow the devices and components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a Bill of Materials for each HVAC Control System. The Bill of Materials shall function as the Table of Contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB. The ECB shall be submitted along with Submittal SD-04, Drawings.

Commissioning Procedures; G, RE

Six copies of the HVAC control system commissioning procedures, in booklet form and indexed, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal unit control system. The Commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The Commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.

a. The Commissioning procedures shall include detailed, product specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.

b. An HVAC control system commissioning procedures equipment list shall be included that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Performance Verification Test Procedures; G, RE

Six copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Training; G, RE

An outline for the HVAC control system training course with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training. Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course.

Preventive Maintenance Software; G, RE

Provide one licensed copy of the software planned to be used.

SD-06 Test Reports

Commissioning Report; G, RE

Six copies of the HVAC Control System Commissioning Report, in booklet form and indexed, within 30 days after completion of the system commissioning. The commissioning report shall include data collected during the HVAC control system commissioning procedures and shall follow the format of the commissioning procedures. The commissioning report shall include all configuration checksheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, results of adjustments, and results of testing.

Performance Verification Test; G, RE

Six copies of the HVAC Control System Performance Verification Test Report, in booklet form and indexed, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of all data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

SD-10 Operation and Maintenance Data

Operation Manual; G, RE

Maintenance and Repair Manual; G, RE

Six copies of the HVAC Control System Operation Manual and HVAC Control System Maintenance and Repair Manual, for each HVAC control system, 30 days before the date scheduled for the training course.

1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

1.5 OPERATION MANUAL

An HVAC control system operation manual in indexed booklet form shall be provided for each HVAC control system. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built configuration checksheets, the procedures for changing HVAC control system setpoints, and the procedures for placing HVAC system controllers in the manual control mode.

a. The procedures for changing HVAC control system setpoints shall describe the step-by-step procedures required to change the process variable setpoints, the alarm setpoints, the bias settings, and setpoint reset schedules.

b. The procedures for placing HVAC system controllers in the manual control mode shall describe step-by-step procedures required to obtain manual control of each controlled device and to manually adjust their positions.

1.6 MAINTENANCE AND REPAIR MANUAL

An HVAC control system maintenance and repair manual in indexed booklet form in hardback binders shall be provided for each HVAC control system. The maintenance and repair manual shall include the routine maintenance

checklist, a recommended repair methods list, a list of recommended maintenance and repair tools, the qualified service organization list, the as-built commissioning procedures and report, the as-built performance verification test procedures and report, and the as-built equipment data booklet.

a. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all devices listed in the equipment compliance booklet, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

b. The recommended repair methods list shall be arranged in a columnar format and shall list all devices in the equipment data compliance booklet and state the guidance on recommended repair methods, either field repair, factory repair, or whole-item replacement.

c. The as-built equipment data booklet shall include the equipment compliance booklet and manufacturer supplied user manuals and information.

d. If the operation manual and the maintenance and repair manual are provided in a common volume, they shall be clearly differentiated and separately indexed.

1.7 MAINTENANCE AND SERVICE

Services, materials and equipment shall be provided as necessary to maintain the entire system in an operational state as specified for a period of one year after successful completion and acceptance of the Performance Verification Test. Impacts on facility operations shall be minimized.

1.7.1 Description of Work

The adjustment and repair of the system shall include the manufacturer's required adjustments of computer equipment, software updates, transmission equipment and instrumentation and control devices.

1.7.2 Personnel

Service personnel shall be qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

1.7.3 Scheduled Inspections

Two inspections shall be performed at six-month intervals and all work required shall be performed. Inspections shall be scheduled in June and December. These inspections shall include:

a. Visual checks and operational tests of equipment.

b. Fan checks and filter changes for control system equipment.

c. Clean control system equipment including interior and exterior surfaces.

d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog points during the first inspection. Check and calibrate the remaining 50 percent of the analog points during the second major inspection. Certify analog test instrumentation accuracy to be twice that of the device being calibrated. Randomly check at least 25 percent of all digital points for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital points during the second inspection.

e. Run system software diagnostics and correct diagnosed problems.

f. Resolve any previous outstanding problems.

1.7.4 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays.

1.7.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition within three calendar days after receiving a request for service.

1.7.6 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the performance verification test.

1.7.7 Records and Logs

Dated records and logs shall be kept of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain initial analog span and zero calibration values and digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

1.7.8 Work Requests

Each service call request shall be recorded as received and shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be

done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. A record of the work performed shall be submitted within 5 days after work is accomplished.

1.7.9 System Modifications

Recommendations for system modification shall be submitted in writing. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.7.10 Software

Updates to the software shall be provided for system, operating and application software, and operation in the system shall be verified. Updates shall be incorporated into operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the latest released version of the Contractor's software shall be installed and validated.

1.8 FACTORY TESTING

The Contractor shall assemble the factory test DDC system as specified and shall perform test to demonstrate that the performance of the system satisfies the requirements of this specification. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of data produced, including results of each test procedure during factory testing shall be delivered to the Government at the conclusion of testing, prior to Government approval of the test. The test results documentation shall be arranged so that commands, responses, and data acquired are correlated in a manner which will allow for logical interpretation of the data.

1.8.1 Factory Test Setup

The factory test setup shall include the following:

a. Central workstation/tester.

b. Printer.

c. DDC test set.

d. Portable workstation/tester.

e. Communication links of each type and speed including MODEMs.

f. Dial-up MODEM.

g. Software.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

Units of the same type of equipment shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two years' use shall include applications of equipment and materials under similar circumstances and of similar size. The two years' experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. Items of the same type and purpose shall be identical, including equipment, assemblies, parts and components. Automatic temperature controls shall be direct digital controls that will provide the required sequence of operation.

2.1.1 Electrical and Electronic Devices

Electrical, electronic, and electropneumatic devices not located within a DDC panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown.

2.1.2 Standard Signals

Except for air distribution terminal unit control equipment, the output of all analog transmitters and the analog input and output of all DDC controllers shall be 4-to-20 mAdc signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

2.1.3 Ambient Temperature Limits

DDC panels shall have ambient condition ratings of 1.7 to 49 degrees C and 10 to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 37 to plus 66 degrees C. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

2.2 TUBING

2.2.1 Copper

Copper tubing shall conform to ASTM B 88, ASTM B 88M and shall have sweat fittings and valves.

2.2.2 Stainless Steel

Stainless steel tubing shall conform to ASTM A 269 and shall have stainless steel compression fittings.

2.2.3 Plastic

Plastic tubing shall have barbed fittings and valves. Plastic tubing shall have the burning characteristics of linear low-density polyethylene tubing, shall be self-extinguishing when tested in accordance with ASTM D 635, shall have UL 94 V-2 flammability classification, and shall withstand stress cracking when tested in accordance with ASTM D 1693. Plastic-tubing bundles shall be provided with Mylar barrier and flame-retardant polyethylene jacket.

2.3 WIRING

2.3.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

2.3.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

2.3.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

2.3.4 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single- or multiple-twisted, minimum 50 mm lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.3.5 Transformers

Step down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508 and NEMA ST 1.

2.4 ACTUATORS

Actuators shall be electric or electronic as shown and shall be provided with mounting and connecting hardware. Electric or electronic actuators shall be used for variable air volume (VAV) air terminal units. Actuators shall fail to their spring-return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 90 seconds or less. Electric actuators shall have an oil-immersed gear train. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric or electronic actuators used in sequencing applications shall have an adjustable operating range and start point.

2.4.1 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

2.4.2 Positive Positioners

Positive positioners are required for pneumatic actuators. Each positive positioner shall be a pneumatic relay with a mechanical feedback mechanism and an adjustable operating range and starting point.

2.5 AUTOMATIC CONTROL VALVES

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Unless otherwise stated, valves shall have globe style bodies. Valve bodies shall be designed for not less than 862 kPa working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Kv . Unless otherwise specified, bodies for valves 40 mm and smaller shall be brass or bronze, with threaded or union ends; bodies for 50 mm valves shall have threaded ends; and bodies for valves 50 to 80 mm shall be of brass, bronze or iron. Bodies for valves 65 mm and larger shall be provided with flanged-end connections. Valve Kv shall be within 100 to 125 percent of the Kv shown.

2.5.1 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 29 to plus 121 degrees C. Valves shall have a manual means of operation independent of the actuator. The rated Kv for butterfly valves shall be the value Kv at 70% open (60 degrees open).

2.5.2 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

2.5.3 Three-Way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

2.5.4 Duct-Coil and Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided for duct or terminal-unit coils. Flare nuts shall be furnished for each flare-type end valve.

2.5.5 Valves for Chilled-Water, Condenser-Water, and Glycol Service

Internal valve trim shall be bronze except that valve stems may be type 316 stainless steel. Valve Kv shall be within 100 to 125 percent of the Kv shown. Valves 100 mm and larger shall be butterfly.

2.5.6 Valves for Hot-Water Service

For hot water service below 122 degrees C and dual-temperature service, internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 99 degrees C shall be Type 316 stainless steel. Internal trim for valves controlling water 99 degrees C or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 121 degrees C or 28 degrees C above the system design temperature, whichever is higher. Valves 100 mm and larger shall be butterfly valves.

2.6 DAMPERS

2.6.1 Damper Assembly

A single damper section shall have blades no longer than 1.2 meters and shall be no higher than 1.8 meters. Maximum damper blade width shall be 203 mm. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream. Damper axles shall be 13 mm minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 10 Pa at 5.1 m/s in the wide-open position. Frames shall not be less than 50 mm in width. Dampers shall be tested in accordance with AMCA 500.

2.6.2 Operating Links

Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel.

Adjustments of crankarms shall control the open and closed positions of dampers.

2.6.3 Damper Types

Dampers shall be parallel-blade type.

2.6.3.1 Outside Air, Return Air, and Relief Air Dampers

Outside air, return air and relief air dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 102 L/s per square meter at 1017 Pa static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 94 degrees C. Dampers shall be rated at not less than 10 m/s air velocity.

2.6.3.2 Mechanical and Electrical Space Ventilation Dampers

Mechanical and electrical space ventilation dampers shall be as shown. Dampers shall not leak in excess of 406 L/s per square meter at 1017 Pa static pressure when closed. Dampers shall be rated at not less than 7.6 m/s air velocity.

2.6.3.3 Smoke Dampers

Smoke-damper and actuator assembly required per NFPA 90A shall meet the Class II leakage requirements of UL 555S. Dampers shall be rated at not less than 10 m/s air velocity.

2.6.4 Damper End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

2.7 SMOKE DETECTORS

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A. Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 2.5 and 20 m/s. Detectors shall be powered from the HVAC control panel or fire alarm control panel (FACP) as coordinated with the fire alarm system, Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation. A remote annunciation lamp and accessible remote reset switch shall be provided for

duct detectors that are mounted eight feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as the affected fan units shall be properly identified in etched rigid plastic placards.

2.8 INSTRUMENTATION

2.8.1 Measurements

Transmitters shall be calibrated to provide the following measurements, over the indicated ranges, for an output of 4 to 20 mAdc:

a. Conditioned space temperature, from 10 to 30 degrees C .

b. Duct temperature, from 5 to 60 degrees C .

c. Chilled-water temperature, from minus 1 to plus 38 degrees C .

d. Heating hot-water temperature, from 10 to 121 degrees C .

e. Outside-air temperature, from minus 35 to plus 55 degrees C .

f. Relative humidity, 0 to 100 percent for space and duct high-limit applications.

2.8.2 Temperature Instruments

2.8.2.1 Resistance Temperature Detectors (RTD)

Temperature sensors shall be 100 ohms 3- or 4-wire RTD. Each RTD shall be platinum with a tolerance of 0.30 degrees C at 0 degrees C with a temperature coefficient of resistance (TCR) of .00385 ohms/ohm/deg C and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally mounted unless otherwise shown.

2.8.2.2 Continuous Averaging RTD

Continuous averaging RTDs shall have a tolerance of plus or minus 0.5 degrees C at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. The sensing element shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter to match the resistance range of the averaging RTD.

2.8.2.3 RTD Transmitter

The RTD transmitter shall match the resistance range of the RTD. The transmitter shall be a two-wire, loop powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated measurement.

2.8.3 Relative Humidity Instruments

A relative-humidity instrument for indoor application shall have a measurement range from 0 to 100 percent relative-humidity and be rated for operation at ambient air temperatures within the range of minus 4 to plus 55 degrees C . It shall be capable of being exposed to a condensing air stream (100 percent RH) with no adverse effect to the sensor's calibration or other harm to the instrument. The instrument shall be of the wall-mounted or duct-mounted type, as required by the application, and shall be provided with any required accessories. Instruments used in duct high-limit applications shall have a bulk polymer resistive sensing element. Duct-mounted instruments shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The instrument (sensing element and transmitter) shall be a two-wire, loop-powered device and shall have an accuracy of plus or minus three percent of full scale within the range of 20 to 80 percent relative humidity. The instrument shall have a typical long-term stability of 1 percent or less drift per year. The transmitter shall convert the sensing element's output to a linear 4-20 mAdc output signal in proportion to the measured relative-humidity value. The transmitter shall include offset and span adjustments.

2.8.4 NOT USED

2.8.5 NOT USED

2.8.6 Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus two percent of full scale. The transmitter shall be a two-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required pressure measurement.

2.8.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 50 mm lagging neck and extension type well. Inside diameter and insertion length shall be as required for the application.

2.8.8 Sunshields

Sunshields for outside air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The top of each sunshield shall have a galvanized metal rainshield projecting over the face of the sunshield. The sunshields shall be painted white.

2.9 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 5 degrees C of the setpoint shown. Thermostats shall be electronic or electric.

2.9.1 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 3 degrees C. Room thermostats shall be enclosed with separate locking covers (guards).

2.9.2 Microprocessor Based Room Thermostats

Microprocessor based thermostats shall have built-in keypads for scheduling of day and night temperature settings. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all seven days of the week. The time program shall allow two separate temperature setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be 1 degree C. When used for heat pump applications, the thermostat shall have an emergency heat switch.

2.9.3 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 2 to 4 degrees C for each output. Room thermostats shall be enclosed with separate locking covers (guards).

2.9.4 Nonmodulating Capillary Thermostats and Aquastats

Each thermostat shall have a capillary length of at least 1500 mm , shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 3 to 9 degrees C. Aquastats shall be of the strap on type, with 5 degrees C fixed differential.

2.9.5 Freezestats

Freezestats shall be manual reset, low temperature safety thermostats, with NO and NC contacts and a 6000 mm element which shall respond to the coldest 450 mm segment.

2.9.6 Modulating Capillary Thermostats

Each thermostat shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 2 to 4 degrees C for each output.

2.9.7 Fan-Coil Unit Room Thermostats

Fan-coil unit thermostats in personnel living spaces shall be of the low voltage type with locking covers. Electrical rating shall not exceed 2.5 amperes at 30 volts ac. Housing shall be corrosion resisting metal or molded plastic. Transformer and fan relay shall be provided for the proper operation of each thermostatic control system as necessary to suit the design of the control system using the thermostats specified below. Dual element heating cooling thermostats shall be provided. Motor speed switches shall be provided for three-speed fan control.

2.9.7.1 NOT USED

2.9.7.2 NOT USED

2.9.7.3 Combination Thermostat

Fan coil unit combination heating-cooling thermostats shall be provided with separate temperature sensing elements for each system, and shall have a single-pole, single-throw (SPST) switch, hermetically sealed and actuated by a bimetallic or bellows type element. Each element shall operate switches to provide single stage control for heating and cooling. Scales and ranges shall be as specified for individual thermostats. Thermostats shall contain, or a subbase shall be provided which contains, selector switches for Heat-Off-Cool. A changeover controller providing automatic summer-winter changeover for thermostats by sensing the supplied fluid temperature shall be provided. A limited range heating-cooling dead band thermostat shall control cooling when temperature is above the upper setpoint and heating when temperature is below the lower setpoint and shall have a dead band, with no heating or cooling, when temperature is between the setpoints. Setpoint adjustment shall be concealed.

2.10 PRESSURE SWITCHES AND SOLENOID VALVES

2.10.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.10.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings, ambient air pressure fittings, and/or hydronic fittings, designed to sense pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 6 Pa at the low end of the range and 85 Pa at the high end of the range.

2.11 INDICATING DEVICES

2.11.1 Thermometers

Mercury shall not be used in thermometers.

2.11.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 230 mm scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

2.11.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.11.1.3 Nonaveraging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.11.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 90 mm (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

2.11.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus one percent of scale range. Thermometers shall have a range suitable for the application.

2.11.2 Pressure Gauges

Gauges shall be 50 mm (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus three percent of scale range. Gauges shall meet requirements of ASME B40.1.

2.11.2.1 NOT USED

2.11.2.2 NOT USED

2.11.2.3 Hydronic System Gauges

Gauges for hydronic system applications shall have ranges and graduations as shown.

2.11.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements shall be a minimum of 90 mm (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus two percent of scale range.

2.12 CONTROL DEVICES AND ACCESSORIES

2.12.1 Relays

Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts (two normally open, two normally closed) enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage. Time delay relays shall be 2PDT with eight-pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall not be greater than three watts.

2.12.2 NOT USED

2.12.3 Joule or Watthour Meters

Joule meters shall be in accordance with ANSI C12.1 and have pulse initiators for remote monitoring of Joule consumption. Pulse initiator shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1.

2.12.4 Joule or Watthour Meters with Demand Register

Meters shall be in accordance with ANSI C12.1 and shall have pulse initiators for remote monitoring of Joule consumption and instantaneous demand. Pulse initiators shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1

2.12.5 Joule or Watthour Transducers

Joule transducers shall have an accuracy of plus or minus 0.25 percent for kW and Joule outputs from full lag to full lead power factor. Input ranges for kW and Joule transducers shall be selectable without requiring the changing of current or potential transformers. The output shall be 4 to 20 mAdc.

2.12.6 Current Sensing Relays

Current sensing relays shall provide a normally-open contact rated at a minimum of 50 volts peak and 1/2 ampere or 25 VA, noninductive. There shall be a single hole for passage of current carrying conductors. The devices shall be sized for operation at 50 percent rated current based on the connected load. Voltage isolation shall be a minimum of 600 volts.

2.13 NOT USED

2.14 DIRECT DIGITAL CONTROL (DDC) HARDWARE

All functions, constraints, data base parameters, operator developed programs and any other data shall be downloadable from a portable workstation/tester or the central workstation/tester to network control panels, RIU's, universal programmable controllers, and unitary controllers. Download shall be accomplished through both the primary network and the local DDC portable workstation/tester port.

2.14.1 Network Control Panel

Network control panels shall be microcomputer-based with sufficient memory provided to perform all specified and shown network control panel functions and operations, including spare capacity for all spares and its I/O functions specified. Each network control panel and remote I/O units (RIU) shall have a minimum of 10% of its I/O functions as spare capacity but not less than 2 of each type used in each. The type of spares shall be in the same proportion as the implemented I/O functions on the panel, but in no case shall there be less than two spare points of each type. The panel I/O functions shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points shall necessitate only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator using the central workstation/tester or portable workstation/tester. The panel shall contain all necessary I/O functions to connect to field sensors and control panels. I/O function operation shall be fully supervised to detect I/O function failures. Network control panels shall operate in an independent stand-alone mode, which is defined as all network control panel operations performed by the network control panel without any continuing input from other Direct digital controls or portable workstation/tester. The network control panel shall be capable of controlling a mix of at least 32 RIUs, unitary controllers, and universal programmable controllers.

2.14.1.1 Integral Features

The network control panel shall include:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and if necessary power supply.

d. Manufacturers control network port.

e. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be

available to the panel for further processing.

f. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

g. An intrusion detection device, connected as an alarm.

2.14.1.2 Communication Interfaces

The following communication capabilities shall function simultaneously.

a. Manufacturers Control Network. Manufacturers control network communications interfaces for each data transmission systems (DTS) circuit between network control panels and RIUs, unitary controllers, and universal programmable controllers, shall be provided. Communication interfaces shall be provided between each network control panel and associated I/O functions. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the network control panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. Network control panel workstation/tester port other than RS-232,shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

c. Primary Network Port. The network control panel shall either have a built in primary network Port or be capable of accepting a primary network port expansion card for future networking to a base wide utility monitoring and control system (UMCS). The primary network port expansion card shall be either Ethernet (IEEE802.3) or ARCNET.

2.14.1.3 Memory and Real Time Clock (RTC) Backup

The network control panel memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever a either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

2.14.1.4 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 2 meters of the network control panel enclosure.

2.14.1.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each network control panel.

2.14.1.6 Failure Mode

Upon failure of the network control panel, either due to failure of the network control panel hardware or of the manufacturers control network, the network control panel shall revert to the failure mode as shown.

a. Manufacturers Control Network Failure: Upon failure of the manufacturers control network, the network control panel shall operate in an independent stand-alone mode.

b. Network Control Panel Hardware Failure: Upon failure of the network control panel hardware, the network control panel shall cease operation and stop communications with other network control panels, RIUs, unitary controllers and universal programmable controllers connected to the affected network control panel. The affected network control panel shall respond to this failure as specified and shown.

2.14.2 RIU

The RIU shall be functionally a part of the network control panel as specified, but may be remotely located from the network control panel and communicate over a dedicated communication circuit. When remotely located, the I/O functions shall be subject to the same requirements as for the network control panel hardware. RIUs shall be used to connect remote inputs and outputs to a network control panel and shall contain all necessary I/O functions to connect to field sensors and control devices. RIU operation shall be fully supervised by the network control panel to detect failures. Each RIU shall have a minimum of 10 % of its I/O functions as spare capacity. The type of spares shall be in the same proportion as the implemented I/O functions on the RIU, but in no case shall there be less than two spare points of each type. The RIU shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points by others shall require only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator. The RIU shall either report the status of all connected points on each scan, or report the status of all points which have changed state or value since the previous scan.

2.14.2.1 Integral Features

The RIU shall include:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and if necessary power supply.

d. Manufacturers control network port.

e. On-Off-Auto switches for each DO which controls a device. These

switches shall be mounted in the RIU, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the RIU for further processing.

f. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

g. An intrusion detection device, connected as an alarm.

2.14.2.2 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 2 meters of the RIU.

2.14.2.3 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each RIU.

2.14.2.4 Failure Mode

Upon failure of the RIU, either due to failure of the RIU hardware or of the DTS, the RIU shall revert to the failure mode shown.

2.14.3 Universal Programmable Controller (UPC)

The universal programmable controller shall be a microprocessor based controller designed and programmed to control and monitor systems as shown. Resident programs shall be contained in reprogrammable nonvolatile memory. Each universal programmable controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures. It shall provide for operation as a device connected to the system via the manufacturers control network.

2.14.3.1 Integral Features

The universal programmable controller shall include as a minimum:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and if necessary power supply.

d. Manufacturers control network port.

e. I/O functions

(1) 8 DI

(2) 4 DO

(3) 8 AI

(4) 4 AO

(5) 1 PA

f. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the universal programmable controller, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.

g. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

2.14.3.2 Communication Interfaces

The UPC shall have the following communication capabilities which shall function simultaneously.

a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the UPC and a network control panels shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the UPC Panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A UPC workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

2.14.3.3 Memory and RTC Backup

The UPC memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever a either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

2.14.3.4 Specific Requirements

Each universal programmable controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and

monitoring from any DDC controller connected to the same manufacturers control network as the universal programmable controller. This shall be done using a portable workstation/tester connected to a portable workstation/tester port either directly or via modem.

2.14.3.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each enclosure.

2.14.3.6 Failure Mode

Upon failure of the universal programmable controller, it shall revert to the failure mode of operation as shown.

2.14.4 Unitary Controller

The unitary controller shall be a microprocessor based, stand-alone, dedicated purpose controller, communicating with the network control panel, designed and programmed to control air distribution system mixing boxes, terminal units, heat pumps, fan coil units, self-contained DX units or VAV boxes as shown. Each unitary controller shall contain resident programs in nonvolatile memory for each specific application implemented. Each unitary controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures and shall provide for operation as a device connected to the network control panel via the manufacturers control network.

2.14.4.1 Integral Features

The unitary controller shall include:

a. Main power switch.

b. Power on indicator.

c. Portable workstation/tester port, connector, and power supply.

d. Manufacturers control network port.

e. All I/O functions required to implement the requirements as shown.

f. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.

g. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual

output override, for each AO. The status of these shall be available to the panel for further processing.

2.14.4.2 Communication Interfaces

The unitary controller shall have the following communication capabilities which shall function simultaneously.

a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the unitary controller and a network control panel shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the unitary control panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A unitary controller workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel. For unitary controller applications where the controller is not mounted in an enclosure, such as for fan-coil units or VAV terminal units, a portable conversion device for an RS-232 connection to the portable workstation/tester may be provided.

2.14.4.3 Specific Requirements

Unitary controller components for new air distribution terminal units shall be furnished to the air distribution terminal unit manufacturer for factory mounting and calibration. Existing air distribution terminal units shall be controlled by field installed unitary controllers.

a. Accessibility and Interfaces: Each unitary controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and monitoring using a portable workstation/tester connected to the manufacturers control network. They shall also be accessible with a portable workstation/tester connected to the unitary controller portable workstation/tester port.

2.14.4.4 Failure Mode

Upon failure of the unitary controller, it shall revert to the failure mode of operation as shown.

2.14.5 Chiller Control Panel

Chiller control panel shall be microprocessor-based and shall provide, both locally and through the Manufacturers Control Network, the control, monitoring, and safety equipment functions provided by the chiller manufacturer's control panel(s) (two communications ports total). The chiller control panel instrumentation and control ranges and accuracies shall match those of the chiller manufacturer's control devices. The chiller panel shall have a communication port for interface to a Portable Workstation/Tester through either the Manufacturers Control Network or modem for chiller(s) start/stop, chilled water temperature reset, and

monitoring of chiller operating status, alarms, and power consumption.

2.14.6 Boiler Control Panel

Boiler control panel shall be microprocessor-based and shall provide, both locally and through the Manufacturers Control Network, the control, monitoring, and safety equipment functions provided by the boiler manufacturer's control panel(s) (two communications ports total). The boiler control panel instrumentation and controls ranges and accuracies shall match those of the boiler manufacturer's control devices. The boiler panel shall have a communication port for interface to a Portable Workstation/Tester through either the Manufacturers Control Network or modem for boiler(s) and start/stop, boiler water temperature reset, and monitoring of boiler operating status, alarms.

2.14.7 I/O Functions

2.14.7.1 DDC Hardware I/O Functions

I/O Functions shall be provided as part of the DDC system and shall be in accordance with the following:

a. The analog input (AI) function shall monitor each analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. The A-to-D conversion shall have a minimum resolution of 10 bits plus sign. Signal conditioning shall be provided for each analog input. Analog inputs shall be individually calibrated for zero and span, in hardware or in software. The AI shall incorporate common mode noise rejection of 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of 20 dB at 60 Hz from a source impedance of 10,000 ohms. Input ranges shall be within the range of 4-to-20 mAdc.

b. The analog output (AO) function shall accept digital data, perform D-to-A conversion, and output a signal within the range of 4-to-20 mAdc. D-to-A conversion shall have a minimum resolution of eight bits plus sign. Analog outputs shall be individually calibrated for zero and span. Short circuit protection on voltage outputs and open circuit protection on current outputs shall be provided. An individual gradual switch for manual override of each analog output and means of physically securing access to these switches shall be provided. Each AO shall have a three-position switch for selection of the DDC control signal, no control, or a locally generated control signal for connection to the controlled device. Feedback shall be provided to the system as to the status of the output (manual control or automatic). Switches for pneumatic control outputs shall provide a connection for an externally generated pneumatic signal. All switches shall be either of a key operated design with the same keying system used for other outputs or otherwise suitably protected from unauthorized access.

c. The digital input (DI) function shall accept on-off, open-close, or other change of state (two state data) indications. Isolation and protection against an applied steady-state voltage up to 180 Vac peak shall be provided.

d. The digital output (DO) function shall provide contact closures for momentary and maintained operation of output devices. Closures shall have a minimum duration of 0.1 second. DO relays shall have an initial breakdown voltage between contacts and coil of at least 500 V peak. Electromagnetic interference suppression shall be furnished on all output lines to limit transients to nondamaging levels. Protection against an applied steady-state voltage up to 180 Vac peak shall be provided. Minimum contact rating shall be one ampere at 24 Vac. Key locked HOA switches shall be provided for manual override of each digital output. Feedback shall be provided to the system as to the status of the output (manual control or automatic). Switches shall be common keyed.

e. The pulse accumulator function shall have the same characteristics as the DI. In addition, a buffer shall be provided to totalize pulses and allow for interrogation by the DDC system. The pulse accumulator shall accept rates up to 20 pulses per second. The totalized value shall be reset to zero upon operator's command.

f. Signal conditioning for sensors shall be provided as specified.

g. The binary coded decimal (BCD) function: The BCD function shall have the same characteristics as the DI, except that, in addition, a buffer shall be provided to totalize inputs and allow for interrogation by the network control panel. The BCD function shall have 16-channel optically isolated buffered inputs to read four digit numbers. The BCD function shall accumulate inputs at rates up to 10 inputs per second.

2.14.7.2 Failure Mode

Upon failure of the I/O function, including data transmission failure, logic power supply failure, DDC processor malfunction, software failure, interposing relay power failure, or any other failure which prevents stand alone operation of any DDC normally capable of stand alone operation, connected outputs shall be forced to the failure mode shown.

2.14.8 Portable Workstation/Tester

A portable workstation/tester shall be provided and shall be able to connect to any DDC hardware. The portable workstation/tester shall consist of a portable computer with a nominal 14 inch active color matrix liquid crystal display, capable of displaying up to 64k colors at a minimum resolution of 1024 X 768 pixels, an external VGA monitor port, 32 bit microprocessor operating at a minimum of 1 GHZ. Operating system shall be Windows XP Professional. The portable workstation/tester shall have, as a minimum, a 20 GB hard drive, 256 megabytes of memory, integral pointing device, serial and parallel ports, color V.92 video port for an external color monitor, 3.5 inch floppy disk drive, modem, removable CD-R/W drive, PCMCIA type 3 slot, R145 port for 10/100 ethernet rechargeable battery, battery charger and 120 Vac power supply. It shall include carrying case, extra battery, charger and a compatible network adapter. The workstation/tester shall:

a. Run DDC diagnostics.

b. Load all DDC memory resident programs and information, including parameters and constraints.

c. Display any AI, DI, AO, DO, or PA point in engineering units for analog points or status for digital points.

d. Control any AO or DO.

e. Provide an operator interface, contingent on password level, allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.

f. Display database parameters.

g. Modify database parameters.

h. Accept DDC software and information for subsequent loading into a specific DDC. Provide all necessary software and hardware required to support this function, including an EIA ANSI/EIA/TIA-232-F port.

i. Disable/enable each DDC.

j. Perform all workstation functions as specified.

2.14.9 Central Workstation/Tester

A central workstation/tester shall be provided and shall be able to communicate any network control panel via the primary network. The central workstation/tester shall be functionally equivalent to the portable workstation/tester but is intended to be a stationary unit. The central workstation/tester shall consist of a central computer with a nominal 17 inch VGA color display, capable of displaying up to 64k colors at a minimum resolution of 1024 X 76 pixels, 32 bit microprocessor operating at a minimum of 1 GHZ. Operating System shall be Windows XP Professional. The central workstation/tester shall have, as a minimum, a 406B hard drive, 256 megabytes of memory, integral pointing device, serial and parallel ports, color 15 pin video port for an external color monitor, 3.5 inch floppy disk drive, V.92 modem, CD-R/W Drive, PCMCIA type three slot, 120 Vac power supply and network adapter (Ethernet IEEE802.3 or ARCNET). The central workstation/tester shall:

a. Run DDC diagnostics.

b. Load all DDC memory resident programs and information, including parameters and constraints.

c. Display any AI, DI, AO, DO, or PA point in engineering units for analog points or status for digital points.

d. Control any AO or DO.

e. Provide an operator interface, contingent on password level, allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.

f. Display database parameters.

g. Modify database parameters.

h. Accept DDC software and information for subsequent loading into a specific DDC. Provide all necessary software and hardware required to support this function, including an EIA ANSI/EIA/TIA-232-F port.

i. Disable/enable each DDC.

j. Perform all workstation functions as specified.

2.14.10 Data Terminal Cabinet (DTC)

The DTC shall be an independent metallic enclosure not physically part of the network control panel/RIU as shown. The DTC shall be sized to accommodate the number of I/O functions required for each network control panel/RIU, including installed spares, plus 10% expansion for each type of I/O function provided. The DTC shall be divided into analog input and output groups and digital input and output groups. The DTC shall be provided with double sided screw type terminal strips. One side of the terminal strip shall be used for termination of field wiring from instrumentation-mentation and controls. The other side shall be used to connect the DTC to the network control panel/RIU. Terminal strips shall have individual terminal identification numbers. The DTC shall be a locking type mounting enclosure, with common keying and door switch wired to an input for intrusion alarm annunciation at the central station. DTC keying shall be identical to network control panel/RIU keying.

2.15 DDC SOFTWARE

All DDC software described in this specification shall be furnished as part of the complete DDC System.

2.15.1 Operating System

Each DDC shall contain an operating system that controls and schedules that DDC's activities in real time. The DDC shall maintain a point database in its memory that includes all parameters, constraints, and the latest value or status of all points connected to that DDC. The execution of DDC application programs shall utilize the data in memory resident files. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. Each DDC real time clock shall be automatically synchronized with the network control panel real time clock at least once per day to plus or minus 10 seconds. When the network control panel is connected to a central workstation/tester, the network control panel RTC shall be updated by the central workstation/tester RTC. The time synchronization shall be accomplished without operator intervention and without requiring system shutdown. The operating system shall allow loading of software, data files data entry, and diagnostics from the central workstation/tester both locally through the central workstation/tester port and remotely through a network control panel and the manufacturers control network.

2.15.1.1 Startup

The DDC shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions. A DDC restart program based on detection of power failure at the DDC shall be included in the DDC software. Upon restoration of power to the DDC, the program shall restart equipment and restore loads to the state at time of power failure, or to the state as commanded by time programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the DDC, if the database and application software are no longer resident or if the clock cannot be read, the DDC shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the database and application programs are resident, the DDC shall resume operation after an adjustable time delay of from 0 to 600 seconds. The startup sequence for each DDC shall include a unique time delay setting for each control output when system operation is initiated.

2.15.1.2 Operating Mode

Each DDC shall control and monitor functions as specified, independent of communications with other DDC. This software shall perform all DDC functions and DDC resident application programs as specified using data obtained from I/O functions and based upon the DDC real time clock function. When communications circuits between the DDC are operable, the DDC shall obtain real time clock updates and any required global data values transmitted from other network control panels. The DDC software shall execute commands after performing constraints checks in the DDC. Status and analog values, including alarms and other data shall be transmitted from other network control panels when communications circuits are operable. If communications are not available, each DDC shall function in stand-alone mode and operational data, including the latest status and value of each point and results of calculations, normally transmitted from other network control panels shall be stored for later transmission to the network control panel. Storage for the latest 256 values shall be provided at each network control panel. Each DDC shall accept software downloaded from the network control panel. Constraints shall reside at the DDC.

2.15.1.3 Failure Mode

Upon failure for any reason, each DDC shall perform an orderly shutdown and force all DDC outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

2.15.2 Functions

The Contractor shall provide software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within each network control panel, RIU, unitary controller and universal programmable controller.

a. Scanning of inputs.

b. Control of outputs.

c. Reporting of analog changes outside a selectable differential.

d. Reporting of unauthorized digital status.

e. Reporting of alarms automatically to network control panel.

f. Reporting of I/O status to network control panel upon request.

g. Maintenance of real time, updated by the network control panel at least once a day.

h. Communication with the network control panel.

i. Execution of DDC resident application programs.

j. Averaging or filtering of AIs.

k. Constraints checks (prior to command issuance).

l. Diagnostics.

m. Portable workstation/tester operation as specified.

n. Reset of PA by operator based on time and value.

2.15.2.1 Analog Monitoring

The system shall measure and transmit analog values including calculated analog points. An analog change in value is defined as a change exceeding a preset differential value as specified. The record transmitted for each analog value shall include a readily identifiable flag which indicates the abnormal status of the value when it deviates from operator selectable upper and lower analog limits. Analog values shall be expressed in proper engineering units with sign. Engineering units conversions shall be provided for each measurement. Each engineering units conversion set shall include range, span, and conversion equation. A vocabulary of engineering unit descriptors shall be provided, using at least three alphanumeric characters to identify information in the system. The system shall support 255 different engineering units.

2.15.2.2 Logic (Virtual) Points

Logic (virtual) points shall be software points entered in the point database which are not directly associated with a physical I/O function. Logic (virtual) points shall be analog or digital points created by calculation from any combination of digital and analog points, or other data having the properties of real points, including alarms, without the associated hardware. Logic (virtual) points shall be defined or calculated and entered into the database by the Contractor. The calculated analog point shall have point identification in the same format as any other

analog point. The calculated point shall be used in any program where the real value is not obtainable directly. Constants used in calculations shall be changeable on-line by the operator. Calculated point values shall be current for use by the system within 10 seconds of the time of any input changes.

2.15.2.3 State Variables

If an analog point represents more than two (up to eight) specific states, each state shall be nameable. For example, a level sensor shall be displayed at its measured engineering units plus a state variable with named states usable in programs or for display such as low alarm/low/normal/high/high alarm.

2.15.2.4 Analog Totalization

Any analog point shall be operator assignable to the totalization program. Up to eight analog values shall be totalized within a selectable time period. At the end of the period, the totals shall be stored. Totalization shall then restart from zero for the next time period. The program shall keep track of the peak and total value measured during the current period and for the previous period. The operator shall be able to set or reset each totalized value individually. The time period shall be able to be operator defined, modified or deleted on-line.

2.15.2.5 Energy Totalization

The system shall calculate the heat energy in Btus, for each energy source consumed by the mechanical systems specified, totalize the calculated Btus, the instantaneous rate in Btus per hour, and store totals in thousands of Btus (MBtu). The Btus calculated shall be totalized for an adjustable time period. The time period shall be defined uniquely for each Btu totalization.

2.15.2.6 Trending

Any analog or calculated point shall be operator assignable to the trend program. Up to eight points shall be sampled at individually assigned intervals, selectable between one minute and two hours. A minimum of the most recent 128 samples of each trended point shall be stored. The sample intervals shall be able to be defined, modified, or deleted on-line.

2.15.3 I/O Point Database/Parameter Definition

Each I/O point shall be defined in a database residing in the DDC. The definition shall include all physical parameters associated with each point. Each point shall be defined and entered into the database by the Contractor, including as applicable:

a. Name.

b. Device or sensor type (i.e., sensor, control relay, motors).

c. Point identification number.

d. Unit.

e. Building number.

f. Area.

g. Island.

h. DDC number and channel address.

i. KW (running).

j. KW (starting).

k. Sensor range.

l. Controller range.

m. Sensor span.

n. Controller span.

o. Engineering units conversion (scale factor).

p. Setpoint (analog).

q. High reasonableness value (analog).

r. Low reasonableness value (analog).

s. High alarm limit differential (return to normal).

t. Low alarm limit differential (return to normal).

u. High alarm limit (analog).

v. Low alarm limit (analog).

w. Alarm disable time period upon startup or change of setpoint.

x. Analog change differential (for reporting).

y. Alarm class and associated primary message text.

z. High accumulator limit (pulse).

aa. Status description.

bb. Run time target.

cc. Failure mode as specified and shown.

dd. Constraints as specified.

2.15.4 Alarm Processing

Each DDC shall have alarm processing software for AI, DI, and PA alarms for all real and virtual points connected to that DDC.

2.15.4.1 Digital Alarms Definition

Digital alarms are those abnormal conditions indicated by DIs as specified and shown.

2.15.4.2 Analog Alarms Definition

Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings shall be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits shall be assigned to each analog point in the system. Analog alarm limits shall be stored in the DDC database. Each analog alarm limit shall have an associated unique limit differential specifying the amount by which a variable must return into the proper operating range before being annunciated as a return-to-normal-state. All limits and differentials shall be entered on-line by the operator in limits of the measured variable, without interruption or loss of monitoring of the point concerned. The program shall automatically change the high or low limits or both, of any analog point, based on time scheduled operations as specified, allowing for a time interval before the alarm limit becomes effective. In CPA applications, key the limit to a finite deviation traveling with the setpoint. The system shall automatically suppress analog alarm reporting associated with a digital point when that digital point is turned off.

2.15.4.3 Pulse Accumulator Alarms Definition

Pulse accumulator alarms are those conditions calculated from totalized values of accumulator inputs or PA input rates that are outside defined limits as specified and shown. PA totalized values shall be compared to predefined limits and alarmed each time a value enters a limit condition. Unique limits shall be assigned to each PA point in the system. Limits shall be stored in the DDC database.

2.15.5 Constraints

2.15.5.1 Equipment Constraints Definitions

Each control point in the database shall have DDC resident constraints defined and entered by the Contractor, including as applicable:

a. Maximum starts (cycles) per hour.

b. Minimum off time.

c. Minimum on time.

d. High limit (value in engineering units).

e. Low limit (value in engineering units).

2.15.5.2 Constraints Checks

Control devices connected to the system shall have the DDC memory resident constraints checked before each command is issued to insure that no equipment damage will result from improper operation. Each command shall be executed by the DDC only after all constraints checks have been passed. Each command point shall have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value shall be assigned to each AI. Values outside the reasonableness limits shall be rejected and an alarm message sent to the network control panel or portable workstation/tester. Status changes and analog point values shall be reported to the workstation upon operator request, such as for reports, alphanumeric displays, graphic displays, and application programs. Each individual point shall be capable of being selectively disabled by the operator from a workstation/tester. Disabling a point shall prohibit monitoring and automatic control of that point.

2.15.6 Diagnostics

Each DDC shall have self-test diagnostic routines implemented in firmware. The tests shall include routines that exercise memory. Diagnostic software shall be usable in conjunction with the central workstation/tester and portable workstation/tester. The software shall display messages in English to inform the tester's operator of diagnosed problems.

2.15.7 Summer-Winter Operation Monitoring

The system shall provide software to automatically change the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system from summer to winter and vice-versa. The software shall provide automatic commands to applications programs to coordinate proper summer or winter operation. Change over setpoints shall be operator selectable and settable.

2.15.8 Control Sequences and Control Loops

Sufficient memory shall be provided to implement the requirements specified and shown for each DDC. Specific functions to be implemented are defined in individual system control sequences and database tables shown in the drawings, and shall include, as applicable, the following:

a. PI Control: This function shall provide proportional control and proportional plus integral control.

b. Two Position Control: This function shall provide control for a two state device by comparing a set point against a process variable and an established deadband.

c. Floating Point Control: This function shall exercise control when an error signal exceeds a selected deadband, and shall maintain control until the error is within the deadband limits.

d. Signal Selection: This function shall allow the selection of the highest or lowest analog value from a group of analog values as the basis of control. The function shall include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs.

e. Signal Averaging: This function shall allow the mathematical calculation of the average analog value from a group of analog values as the basis of control. The function shall include the ability to "weight" the individual analog values so that the function output can be biased as necessary to achieve proper control.

f. Reset Function: This function shall develop an AO based on up to two AIs and one operator specified reset schedule.

g. Cooling/Heating Operation Program: Software shall be provided to change, either automatically or on operator command, the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system where such a change from cooling to heating and vice versa is meaningful. The software shall provide commands to application programs to coordinate cooling or heating mode operation. Software shall automatically switch facilities from cooling to heating, and vice versa, based on schedules or temperatures. All HVAC equipment and systems shall be assigned to the program.

2.15.9 Command Priorities

A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the on and off states, insuring that the correct command shall be issued when the time constraint is no longer in effect or report the rejected command. Override commands entered by the operator shall have higher priority than those emanating from applications programs.

2.15.10 Resident Application Software

The Contractor shall provide resident applications programs to achieve the sequences of operation, parameters, constraints, and interlocks necessary to provide control of the systems connected to the DDC system. Application programs shall be resident and shall execute in the DDC, and shall coordinate with each other, to insure that no conflicts or contentions remain unresolved. The Contractor shall coordinate the application programs specified with the equipment and controls operation, and other specified requirements. A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the ON and OFF states, insuring that the correct command shall be issued when the time constraint is no longer in effect or the rejected command shall be reported. Override commands entered by the operator shall have higher priority than those emanating from application programs.

2.15.10.1 Program Inputs and Outputs

The Contractor shall select the appropriate program inputs listed for each application program to calculate the required program outputs. Where the specific program inputs are not available, a "default" value or virtual point appropriate for the equipment being controlled and the proposed sequence of operation shall be provided to replace the missing input, thus allowing the application program to operate. AIs to application programs shall have an operator adjustable deadband to preclude short cycling or hunting. Program outputs shall be real analog or digital outputs or logic (virtual) points as required to provide the specified functions. The Contractor shall select the appropriate input and output signals to satisfy the requirements for control of systems as shown.

2.15.10.2 DDC General Conditions

The Contractor shall provide software required to achieve the sequences of operation, parameters, constraints, and interlocks shown. Application software shall be resident in the DDC in addition to any other required software. In the event of a DDC failure, the controlled equipment shall continue to function in the failure mode shown.

2.15.10.3 Scheduled Start/Stop Program

This program shall start and stop equipment based on a time of day schedule for each day of the week, and on a holiday schedule. To eliminate power surges, an operator adjustable time delay shall be provided between consecutive start commands.

a. Program Inputs:

(1) Day of week/holiday.

(2) Time of day.

(3) Cooling and heating high-low alarm limits.

(4) Cooling and heating start-stop schedules.

(5) Cooling or heating mode of operation.

(6) Equipment status.

(7) Equipment constraints.

(8) Consecutive start time delay.

b. Program Outputs: Start/stop signal.

2.15.10.4 Optimum Start/Stop Program

This program shall start and stop equipment as specified for the scheduled start/stop program, but shall include a sliding schedule based on indoor

and outdoor air conditions. The program shall take into account the thermal characteristics of the structure, and indoor and outdoor air conditions, using prediction software to determine the minimum time of HVAC system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end without exceeding space environmental requirements. An adaptive control algorithm shall be utilized to automatically adjust the constants used in the program.

a. Program Inputs:

(1) Day of week/holiday.

(2) Time of day.

(3) Cooling or heating mode of operation.

(4) Equipment status.

(5) Cooling and heating building occupancy schedules.

(6) Space temperature.

(7) Building heating constant (operator adjustable and automatically optimized).

(8) Building cooling constant (operator adjustable and automatically optimized).

(9) OA temperature.

(10) Required space temperature at occupancy (heating).

(11) Required space temperature at occupancy (cooling).

(12) Equipment constraints.

(13) Cooling and heating high-low alarm limits.

b. Program Outputs: Start/stop signal.

2.15.10.5 Day-Night Setback Program

The software shall limit the rise or drop of space temperature (or specified fluid temperature) during unoccupied hours. Whenever the space temperature (or specified fluid temperature) is above (or below for heating) the operator assigned temperature limit, the system shall be turned on until the temperature is within the assigned temperature limit.

a. Program Inputs:

(1) Day of week.

(2) Time of day.

(3) Cooling or heating mode of operation.

(4) Cooling and heating occupancy schedules.

(5) Equipment status.

(6) Space temperature (or specified fluid temperature).

(7) Minimum space temperature (or specified fluid temperature) during unoccupied periods.

(8) Maximum space temperature (or specified fluid temperature) during unoccupied periods.

(9) Equipment constraints.

b. Program Outputs: Start/stop signal.

2.15.10.6 Economizer Program I

The software shall reduce the HVAC system cooling requirements when the OA dry bulb temperature is less than the return air temperature. When the OA dry bulb temperature is above the return air temperature or changeover setpoint, the OA dampers, return air dampers, and relief air dampers shall be positioned to provide minimum required OA. When the OA dry bulb temperature is below a changeover setpoint temperature, the OA dampers, return air dampers, and exhaust air dampers shall be positioned to maintain the required mixed air temperature.

a. Program Input:

(1) Changeover conditions.

(2) OA dry bulb temperature.

(3) RA dry bulb temperature.

(4) Mixed air dry bulb temperature.

(5) Equipment constraints.

b. Program Output: Damper actuator/cooling control signal.

2.15.10.7 Ventilation/Recirculation and Flush Programs

The software shall reduce the HVAC system thermal load for two modes of operation and provide for flushing of the building as follows:

a. Ventilation mode: In this mode, the system shall precool the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and exhaust air damper shall open to their maximum positions and the return air damper shall close to its minimum position.

b. Recirculation mode: In this mode, the system shall preheat the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and the exhaust air damper shall close to their minimum positions and the return air damper shall open to its maximum position.

c. Flush mode: The software shall use the HVAC supply system to provide 100% outside air for ventilation purpose and flush building spaces. The network control panel shall modulate the control valves to maintain the air supply temperature setpoints while the flush program is in effect. The flush mode shall be manually initiated and have the highest priority (it shall override all other programs). The outside air damper and the exhaust air damper shall be closed at other times during unoccupied periods, except for economizer operation during day/night setback periods. For systems without mechanical cooling, this program shall, in addition to the above requirements, act as an economizer. The outside, return, and exhaust air dampers shall be modulated to maintain the required mixed air temperature setpoint. When this program is released, the outside and exhaust air dampers shall return to their minimum positions, and the return air damper shall return to its maximum position.

d. Program Inputs:

(1) Day of week.

(2) Time of day.

(3) Cooling or heating mode of operation.

(4) Equipment status.

(5) Cooling and heating occupancy schedules.

(6) OA dry bulb temperature.

(7) Space temperature.

(8) Equipment constraints.

e. Program Output: Damper actuator control signal.

2.15.10.8 NOT USED

2.15.10.9 Reheat Coil Reset Program

The software shall select the zone with the least amount of heat required. The program shall reset the cold deck discharge temperature upward until it satisfies the zone with the lowest demand, or until the zone humidity control requirements cannot be met.

a. Program Inputs:

(1) Zone RH high limit.

(2) Zone temperature (where shown).

(3) Zone RH (where shown).

(4) Cold deck temperature.

(5) Reheat coil valve positions or proportional signals from primary elements.

(6) Minimum space temperature during occupied periods.

(7) Maximum space temperature during occupied periods.

(8) Equipment constraints.

b. Program Output: Cold deck valve actuator control signal.

2.15.10.10 Heating and Ventilating Unit Program

The software shall control the gas fired burner to maintain space/supply air temperatures for heating and ventilating units. This program shall be coordinated with the ventilation-recirculation program for damper control and the scheduled or optimum start-stop program for fan control.

a. Program Inputs

(1) Space temperature.
(2) Space temperature setpoint.
(3) Supply air temperature.
(4) Supply air temperature setpoint.

b. Program Outputs

(1) Gas-fired burner control signal.
(2) Damper actuator control signal.

2.15.10.11 NOT USED

2.15.10.12 NOT USED

2.15.10.13 NOT USED

2.15.10.14 NOT USED

2.15.10.15 NOT USED

2.15.10.16 NOT USED

2.15.10.17 NOT USED

2.15.10.18 Hot Water OA Reset Program

The software shall reset the hot water temperature supplied by the boiler

or converter in accordance with the OA temperature or other specified independent- dent variable. The hot water supply temperature shall be reset downward or upward from a fixed temperature proportionally, as a function of OA temperature or other specified independent variable.

a. Program Inputs

(1) Reset schedule.
(2) OA dry bulb temperature or other specified independent variable.
(3) Hot water supply temperature.
(4) Maximum hot water supply temperature.
(5) Minimum hot water supply temperature.
(6) Equipment constraints.

b. Program Output: Valve actuator control signal.

2.15.10.19 Boiler Monitoring and Control

The software shall remotely monitor and control boiler operation based on boiler operational data. The program shall monitor inputs and discontinue boiler operation if any monitored point exceeds a predetermined value or changes status incorrectly. The operator shall be able to add or delete individual program input points from the list of points that will discontinue boiler operation.

a. Program Inputs

(1) Flame status.
(2) Hot water flow.
(3) Hot water pressure.
(4) Hot water supply temperature.
(5) Hot water return temperature.
(6) Hot water BTUs.

b. Program Outputs

(1) Boiler enable/disable control signal.
(2) Boiler enable/disable permission to boiler operator for manual control.
(3) Boiler efficiency.

2.16 PREVENTIVE MAINTENANCE (PM) SOFTWARE

The PM software shall be installed on the Central Workstation and shall be compatible with Windows XP Professional.

2.16.1 General

The sofware package at a minimum shall be capable of the following:

(1) Create, track and issue PM procedures.
(2) Provide a detailed description of each piece of equipment in the Training and OMS building, including warranty information.

(3) Provide a detailed work history of each piece of equipment.
(4) Provide a maintenance cost history for each piece of equipment.
(5) Create schedule of upcoming work for a 5-week period.
(6) Have technical support for a minimum of 6-months.
(7) Flexibility to have preventive maintenance set up on weekly, 3-month, 6-month, annual or on a counter.
(8) Flexibility to input and revise the PM database.

2.16.2 Software

Provide one licensed copy of the scheduling software to the government.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION CRITERIA

3.1.1 HVAC Control System

The HVAC control system shall be completely installed and ready for operation. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Software Installation

Software shall be loaded for an operational system, including databases for all points, operational parameters, and system, command, and application software. The Contractor shall provide original and backup copies of source, excluding the general purpose operating systems and utility programs furnished by computer manufacturers and the non-job-specific proprietary code furnished by the system manufacturer, and object modules for software on each type of media utilized, within 30 days of formal Government acceptance. In addition, a copy of individual floppy disks of software for each DDC panel shall be provided.

3.1.3 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

3.1.4 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and DDC panels. Instrumentation grounding shall be installed as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Ground rods installed by the contractor shall be tested as specified in IEEE Std 142. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings. Electrical work shall be as specified in Section 16415A ELECTRICAL WORK, INTERIOR and as shown.

3.2 CONTROL SYSTEM INSTALLATION

3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

3.2.2 NOT USED

3.2.3 Room Instrument Mounting

Room instruments , such as wall mounted thermostats, shall be mounted 1.5 m above the floor unless otherwise shown. Temperature setpoint devices shall be recess mounted.

3.2.4 Freezestats

For each 2 square meters of coil face area, or fraction thereof, a freezestat shall be provided to sense the temperature at the location shown. Manual reset freezestats shall be installed in approved, accessible locations where they can be reset easily. The freezestat sensing element shall be installed in a serpentine pattern.

3.2.5 Averaging Temperature Sensing Elements

Sensing elements shall have a total element minimum length equal to 3 m per square meter of duct cross-sectional area.

3.2.6 Foundations and Housekeeping Pads

Foundations and housekeeping pads shall be provided for the HVAC control system air compressors.

3.2.7 NOT USED

3.2.8 NOT USED

3.2.9 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges

for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

3.3 CONTROL SEQUENCES OF OPERATION

3.3.1 General Requirements - HVAC Systems

See Control Drawings.

3.4 COMMISSIONING PROCEDURES

3.4.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, set the time schedule, and make any necessary control system corrections to ensure that the systems function as described in the sequence of operation.

3.4.1.1 Item Check

Signal levels shall be recorded for the extreme positions of each controlled device. An item-by-item check of the sequence of operation requirements shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shut down; Step 4 shall be performed after the HVAC systems have been started. External input signals to the DDC system (such as starter auxiliary contacts, and external systems) may be simulated in steps 1, 2, and 3. With each operational mode signal change, DDC system output relay contacts shall be observed to ensure that they function.

3.4.1.2 Weather Dependent Test Procedures

Weather dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

3.4.1.3 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the DDC system readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-DDC system readout accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC system readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced

and the calibration check repeated.

3.4.1.4 Insertion and Immersion Temperatures

Insertion temperature and immersion temperature sensing elements and transmitter-to-DDC system readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

3.4.1.5 Averaging Temperature

Averaging temperature sensing element and transmitter-to-DDC system readout calibration accuracy shall be checked every 600 mm along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

3.4.2 NOT USED

3.4.3 Unit Heater and Cabinet Unit Heater

The "OFF/AUTO" switch shall be placed in the "OFF" position. Each space thermostat temperature setting shall be turned up so that it makes contact to turn on the unit heater fans. The unit heater fans shall not start. The "OFF/AUTO" switch shall be placed in the "AUTO" position. It shall be ensured that the unit heater fans start. Each space thermostat temperature setting shall be turned down, and the unit heater fans shall stop. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.4 NOT USED

3.4.5 All-Air Small Packaged Unitary

The schedules shall be manually entered for day temperature and night temperature setpoints as shown. The fan "AUTO/ON" switch shall be set to "ON." The time shall be manually entered as "DAY." The "HEATING/COOLING" switch shall be set to "HEATING" and it shall be ensured that cooling is off. The temperature setpoint shall be raised and it shall be ensured that heating starts. The "HEATING/COOLING" switch shall be set to "COOLING" and it shall be ensured that heat is off. The temperature setpoint shall be lowered and it shall be ensured that cooling starts. The fan "AUTO/ON" switch shall be set to "AUTO" and the foregoing procedure repeated. The fan shall start and stop automatically with the starting and stopping of heating and cooling. The time shall be manually entered as "NIGHT." The foregoing procedures shall be repeated. When the system is verified as operational, the correct "DAY" and "NIGHT" temperature settings shall be restored and the correct time restored. The power to the thermostat shall be shut off and it shall be verified that the thermostat clock keeps time. The results of testing of one of each type of unit shall be logged.

3.4.6 Fan Coil Unit

The dual-temperature hydronic system shall be set to heating. Each space thermostat temperature setting shall be turned up so that it makes contact and turns the fan coil unit on. It shall be ensured that the fan coil unit

fan starts and the valves open to flow through the coils. Each space thermostat temperature setting shall be turned down and it shall be ensured that the fan coil unit fans stop. It shall be ensured that the valves close to flow through the coils. The dual-temperature hydronic system shall be switched to cooling. Each space thermostat temperature setting shall be turned up and it shall be ensured that contact is broken and the fan coil unit fans stop. It shall be ensured that the valves close to flow through the coil. Each space thermostat temperature setting shall be turned down. It shall be ensured that the fan coil unit fans start and the valves open to flow through the coils. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.7 NOT USED

3.4.8 Single Building Hydronic Heating with Hot Water Boiler

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. It shall be verified that power and main air are available where required.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air temperature and system supply temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC system. The proper operation of the actuators and positioners for all valves shall be verified visually. The signal shall be varied from live zero to full range, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) The two-point calibration sensing element-to-DDC system readout accuracy check for the outside air temperature shall be performed. Any necessary software adjustments to setpoints or parameters shall be made to achieve the outside air temperature schedule.

(2) The outside air temperature shall be simulated through an operator entered value to be above the setpoint. It shall be verified that pumps and boiler stop. A value shall be entered to simulate that the outside air temperature is below the setpoint as shown. It shall be verified that pumps start and boiler operates.

(3) The two-point calibration accuracy check of the sensing element-to-DDC system readout for the hydronic system supply temperature shall be performed. The supply temperature setpoint shall be set for the temperature schedule as shown. Signals of 8 ma and 16 ma shall be sent to the DDC system from the outside air temperature sensor, to verify that the supply temperature setpoint changes to the appropriate values.

(4) The control system shall be placed in the occupied mode. The calibration accuracy check of sensing element-to-DDC system readout shall be performed for each space temperature sensor and the values logged. Each space temperature setpoint shall be set as shown. The control system shall be placed in the unoccupied mode, and it shall be verified that each space temperature setpoint changes to the unoccupied mode setting.

3.4.9 NOT USED

3.4.10 NOT USED

3.4.11 NOT USED

3.4.12 NOT USED

3.4.13 Heating and Ventilating Unit

Steps for installation are as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. The system shall be checked to see that power and main air are available where required, the outside air damper and relief air damper are closed, and the return air damper is open.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system readings logged. The calibration accuracy of the sensing element-to-DDC system readout for space temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC system. The proper operation of the actuators and positioners for all dampers and valves shall be verified. The signal shall be varied from live zero to full range, and that the actuators travel from zero stroke to full stroke within the signal range shall be verified. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) With the fan ready to start, the system shall be placed in the ventilation delay mode and in the occupied mode through

operator entered values. It shall be verified that supply fan starts. It shall be verified that the outside air and relief air dampers are closed, the return air damper is open, and the heating coil valve is under control, by artificially changing the space temperature through operator entered values. The system shall be placed out of the ventilation delay mode, and it shall be verified that the outside air, return air, and relief air dampers come under control by simulating a change in space temperature.

(2) The control system shall be placed in the minimum outside air mode. It shall be verified that the outside air damper opens to minimum position.

(3) The calibration accuracy check of sensing element-to-DDC system readout for the space temperature shall be performed. The space temperature setpoint shall be set as shown.

(4) The control system shall be placed in the unoccupied mode, and it shall be verified that the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set as shown.

(5) With the HVAC system running, a filter differential pressure switch input signal shall be simulated, at the device. It shall be verified that the filter alarm is initiated. The differential pressure switch shall be set at the setpoint as shown.

(6) With the HVAC system running, a freezestat trip input signal shall be simulated at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(7) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, and verification of control device actions and interlock functions as described in the Sequence of Operation shall be made. Simulation shall be performed without false-alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm signal is changed to a return-to-normal signal.

3.4.14 NOT USED

3.4.15 NOT USED

3.4.16 NOT USED

3.4.17 NOT USED

3.4.18 NOT USED

3.4.19 Single Zone with Hydronic Heating and Cooling Coils; No Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be verified in its shutdown condition. The system shall be checked to see that power and main air are available where required, that the outside air damper, relief air damper, and cooling coil valve are closed, and that the return air damper is open.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system display readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air, return air, and space temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC system. The proper operation of the actuators and positioners for all dampers and valves shall be visually verified. The signal shall be varied from live zero to full range, and the actuator travel from zero stroke to full stroke within the signal range shall be verified. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) With the fan ready to start, the control system shall be placed in the ventilation delay mode and in the occupied mode, and it shall be verified that supply fan starts. It shall be verified that the outside air and relief air dampers are closed, the return air damper is open, and the heating coil and cooling coil valves are under control, by simulating a change in the space temperature through an operator entered value. The control system shall be placed out of the ventilation delay mode, and it shall be verified that the outside air, return air, and relief air dampers come under control by simulating a change in the space temperature.

(2) The control system shall be placed in the minimum outside air mode. It shall be verified that the outside air damper opens to minimum position.

(3) The economizer mode shall be simulated by a change in the outside air temperature and the return air temperature through operator entered values and it shall be verified that the system goes into the economizer mode. The space temperature shall be

artificially changed through operator entered values to slightly open the outside air damper and the second point of the two-point calibration accuracy check of sensing element-to-DDC system readout for outside air, return air, and space temperatures shall be performed. The space temperature setpoint shall be set as shown.

(4) An unoccupied mode signal shall be applied, and it shall be verified that the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be set to above the night setback setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint as shown.

(5) With the HVAC system running, a filter differential pressure switch input signal shall be simulated at the device. It shall be verified that the filter alarm is initiated. The differential pressure switch shall be set at the setpoint.

(6) With the HVAC system running, a freezestat trip input signal shall be simulated at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(7) With the HVAC system running, a smoke detector trip input signal at each detector shall be simulated, and control device actions and interlock functions as described in the Sequence of Operation shall be verified. Simulation shall be performed without false-alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm returns to normal.

3.5 BALANCING, COMMISSIONING, AND TESTING

3.5.1 Coordination with HVAC System Balancing

Commissioning of the control system, except for tuning of controllers, shall be performed prior to or simultaneous with HVAC system balancing. The contractor shall tune the HVAC control system after all air system and hydronic system balancing has been completed, minimum damper positions set and a report has been issued.

3.5.2 Control System Calibration, Adjustments, and Commissioning

Control system commissioning shall be performed for each HVAC system, using test plans and procedures previously approved by the Government. The Contractor shall provide all personnel, equipment, instrumentation, and

supplies necessary to perform commissioning and testing of the HVAC control system. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Tubing systems shall be tested for leaks. Mechanical control devices shall be adjusted to operate as specified. HVAC control panels shall be pretested off-site as a functioning assembly ready for field connections, calibration, adjustment, and commissioning of the operational HVAC control system. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated. Written notification of any planned commissioning or testing of the HVAC Control systems shall be given to the Government at least 14 calendar days in advance.

3.5.3 Performance Verification Test

The Contractor shall demonstrate compliance of the HVAC control system with the contract documents. Using test plans and procedures previously approved by the Government, the Contractor shall demonstrate all physical and functional requirements of the project. The performance verification test shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt by the Contractor of written permission by the Government, based on Government approval of the Commissioning Report and completion of balancing. The tests shall not be conducted during scheduled seasonal off periods of base heating and cooling systems.

3.5.4 Endurance Test

The endurance test shall be used to demonstrate the specified overall system reliability requirement of the completed system. The endurance test shall not be started until the Government notifies the Contractor in writing that the performance verification test is satisfactorily completed. The Government may terminate the testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

a. Phase I (Testing). The test shall be conducted 24 hours per day, 7 days per week, for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

b. Phase II (Assessment). After the conclusion of Phase I, the Contractor shall identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing

should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and test review meeting, the Government may require that the Phase I test be totally or partially rerun. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

3.5.5 Posted and Panel Instructions

Posted and Panel Instructions, showing the final installed conditions, shall be provided for each system. The posted instructions shall consist of laminated half-size drawings and shall include the control system schematic, equipment schedule, sequence of operation, wiring diagram, communication network diagram, and valve and damper schedules. The posted instructions shall be permanently affixed, by mechanical means, to a wall near the control panel. Panel instructions shall consist of laminated letter-size sheets and shall include a Routine Maintenance Checklist and as-built configuration check sheets. Panel instructions and one copy of the Operation and Maintenance Manuals, previously described herein, shall be placed inside each control panel or permanently affixed, by mechanical means, to a wall near the panel.

3.6 TRAINING

3.6.1 Training Course Requirements

A training course shall be conducted for 6 operating staff members and two preventive maintenance contract personnel designated by the Contracting Officer in the maintenance and operation of the system, including specified hardware and software. The training period, for a total of 32 hours of normal working time, shall be conducted within 30 days after successful completion of the performance verification test. The training course shall be conducted at the project site. Audiovisual equipment and 6 sets of all other training materials and supplies shall be provided. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

3.6.2 Training Course Content

For guidance in planning the required instruction, the Contractor shall assume that attendees will have a high school education or equivalent, and are familiar with HVAC systems. The training course shall cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each HVAC control panel, the layout of one of each type of unitary equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the

physical layout of one such system. The results of the performance verification test and the calibration, adjustment and commissioning report shall be presented as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

-- End of Section --

SECTION 15990A

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Procedural Stds	(1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G, RE

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

SD-03 Product Data

TAB Related HVAC Submittals

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

TAB Procedures; G, RE

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

Systems Readiness Check

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution; G, RE

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; G, RE

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

SD-06 Test Reports

Design Review Report; G, RE

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check; G, RE

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; G, RE

Three copies of the completed TAB Reports, no later that 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report; G, RE

Three copies of the completed TAB Verification Report, no later that 7 days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

SD-07 Certificates

Ductwork Leak Testing

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

TAB Firm; G, RE

Certification of the proposed TAB Firm's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC or NEBB against the proposed TAB Firm shall be described in detail.

TAB Specialist; G, RE

Certification of the proposed TAB Specialist's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC or NEBB against the proposed TAB Specialist shall be described in detail.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC or NEBB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term
TAB Standard	National Standards for	Procedural Standards

SIMILAR TERMS

	Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	for Testing Adjusting Balancing of Environmental Systems.
TAB Specialist	TAB Engineer	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1or NEBB Procedural Stds, unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including building systems commissioning and the measuring of sound and vibration in environmental systems. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor

in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor, and shall report to and be paid by the prime Contractor.

1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC or an experienced technician of the Firm certified by the NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 01460L COMMISSIONING OF HVAC SYSTEMS.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing

devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

3.4 NOT USED

3.5 TESTING, ADJUSTING, AND BALANCING

3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective

action necessary for proper system operation to the Contracting Officer.

3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit the updated TAB report. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

-- End of Section --

SECTION 15996

FACILITY MAINTENANCE
02/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basis designation only.

AMERICAN SOCIETY FOR TESTING AND METERIALS (ASTM)

ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection

AMERICAN SOCIETY HEATING REFRIGERATING, AIR-CONDITIONING ENGINEERS, INC.

STANDARD 62-1999

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code
NFPA 70	National Electric Code

OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION

29 CFR 1910
29 CFR 1926

ENVIRONMENTAL PROTECTION AGENCY (EPA)

40 CFR 302	Environmental Protection

DEPARTMENT OF DEFENSE MINIMUM ANTITERRORISM STANDARDS FOR BUILDINGS

UFC-4-010-01

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals designated "FIO" shall be submitted for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Qualifications; G, RE

Qualifications of proposed personnel for the position of contract supervisor, designated alternate, and journeymen. Include years with firm and years of experience.

Project Master Maintenance Schedule; G, RE

Five copies of the preventive maintenance schedule for the first year shall be provided. This schedule shall include location, equipment nomenclature, task and frequency. Additionally, any calibration or certification requirements shall be identified. The PM procedures provided in Appendix B are a minimal starting point for the development of the contractor prepared master PM schedule. The schedule shall cite all standards which are to be met that have been identified by the contractor

Safety Program; G, RE

Five copies of the Safety and Health Plan including the Accident Prevention Plan, Hazard Analysis and the Lock Out and Tag Plan.

Monthly Reports; G, RE

Five copies showing the format to be used for the monthly detailed report and the monthly completion report.

1.3 SCOPE OF WORK

The contractor shall provide all personnel, equipment, materials, tools, vehicles, supervision, and other items and services, required to perform preventive maintenance services on heating, ventilating, and air conditioning (HVAC) systems and other equipment located in the Army Reserve Center Training/Unit Storage Building and the Organizational Maintenance Shop (OMS) at Fort Story, Virginia for a period of 5 years. The 5-year service period will begin after commissioning is completed and the building owners have taken beneficial occupancy. A separate Notice to Proceed will be issued by the government at the beneficial occupancy date identifying the start of the 5-year period.

The contractor shall also provide all personnel, equipment, materials, tools, vehicles, supervision and any other items required to perform preventive maintenance services on the Diesel Generator Set for the Army Reserve Center Training/Unit Storage Building at Fort Story, Virginia for a period of 5 years. The Diesel Generator itself shall be bid as an option to the Base Bid (refer to contract drawings). The Preventive Maintenance Contract for the generator shall be listed as a separate line item under the preventive maintenance costs and shall be entitled 'Generator Preventive Maintenance Option'.

1.3.1 Mechanical and Plumbing Equipment and Systems

Mechanical and Plumbing equipment and systems requiring maintenance services are identified in Appendix A of this specification section. The PM requirements are set forth in Appendix B of this specification section.

These requirements are considered a minimum. The contractor is also responsible for any preventive task recommended by the equipment manufacturer, and identified in the Operation and Maintenance Manuals.

1.3.2 Diesel Generator Set ('Generator Preventive Maintenance Option')

The generator maintenance services are identified in Appendix C of this specification. The requirements for the generator are located in Appendix D of this specification section. These requirements are considered a minimum. The contract is also responsible for any preventive task recommended by the equipment manufacturer.

1.4 BUILDING DESCRIPTIONS

1.4.1 Training / Unit Storage Building

The Training/ Unit Storage Building is approximately 5848.48 square meters (62,952 square feet). The building is a combination one and two story building, the one story portion is the unit storage area, the two story portion houses the administrative support areas and education spaces.

1.4.1.1 HVAC Systems and Equipment

Natural gas and water are supplied to the building.

The heat generating system for the building is heating hot water, generated by two gas fired hot water boilers. Heating hot water is distributed to air handling units and fan coil units throughout the building.

The cooling for the building is generated by an air-cooled chiller. The chiller is located outside with the evaporator bundle located in the first floor mechanical room. The chilled water is distributed to the air handling units and fan coil units located throughout the building. Refrigerant piping is piped between the evaporator bundle inside and the chiller outside.

An air-handling unit located in the second floor mechanical room provides 100 percent outside air that distributes air throughout the building, meeting ASHRAE Standard 62-99 requirements. Fan coil units are located above the ceiling throughout the building. Each fan coil unit has a heating coil, cooling coil and filter.

1.4.2 OMS Building

Natural gas and water are supplied to the building.

The OMS building is heated and ventilated only with the exception of the two offices, which are heated and cooled by packaged terminal wall air conditioning units.

A gas fired heating ventilating unit is located in the maintenance bay, hung overhead and accessible only via a lift. This unit provides heating and ventilation air to the maintenance bay. All other spaces are heated and ventilated via exhaust fans, intake louvers and unit heaters.

A condensing type boiler is located in the mechanical room generating heating hot water used in the in-floor radiant heating system.

1.4.3 Generator Location

The generator will be located outside just east of the Training Building if the generator option is executed. The generator will provide emergency back-up power for the entire facility through the operation of a manual transfer switch (all life safety equipment will be powered by an integral battery source to satisfy code). The generator will be located in a weather-proof enclosure.

1.5 DEFINITIONS AND ABBREVIATIONS

1.5.1 Definitions

1.5.1.1 Maintenance

Maintenance is the work required to preserve and maintain a facility in such a condition that it may be effectively used for its designated functional purpose. Maintenance includes work done to prevent damage which would be more costly to restore than prevent. Maintenance includes work to sustain components.

1.5.1.2 Preventive Maintenance (PM)

Routine, recurring work performed on all facilities. PM is systematic inspection, care and servicing of equipment and systems in order to detect and correct any incipient failures and accomplishing minor maintenance. Also referred to as PM.

1.5.1.3 Repair

Repair is the restoration of a facility, system or component to such a condition that it may be effectively used for its designated functional purpose. Repair may be overhaul, reprocessing, or replacement of deteriorated components, parts, or materials.

1.5.1.4 Scheduled Maintenance

Scheduled maintenance is the systematic and periodic servicing and inspection of equipment and components to maintain operational efficiency and replace worn and failed parts.

1.5.2 Abbreviations

CO Contracting Officer
COR Contracting Officer Representative
HVAC Heating, Ventilating and Air Conditioning
QA Quality Assurance
QAE Quality Assurance Evaluator
QC Quality Control
O&M Operations and Maintenance
PM Preventive Maintenance

1.6 REQUIREMENTS OF CONTRACTOR

1.6.1 Company Experience Requirement

The contractor shall have experience managing and performing a maintenance contract for HVAC systems and equipment, (and generator equipment as applicable). The experience must have been gained as a result of the company being regularly engaged in the business of providing maintenance services for HVAC equipment (and generator equipment as applicable). The minimum acceptable experience is 2 years. The company shall have demonstrated knowledge of the codes and standards governing the installation, maintenance and repair of HVAC equipment, including but not limited to ASHRAE, ARI, ASME, ASTM, EPA, NFPA, NEMA, OSHA, SAE and UL(as applicable). The contractor shall have a valid refrigerant transition and recovery certification and shall remain abreast of any changes that impact the maintenance of the systems and equipment covered by this contract and shall notify the Contracting Officer in writing of any changes or modifications that may be required to maintain code compliance.

1.6.2 Personnel Experience Requirement

There shall be one supervisor for all work to be done on site. That person shall be responsible for the performance of all work under this contract. The supervisor shall have in-depth knowledge and experience in the maintenance of HVAC systems and equipment (and generator equipment as applicable). The supervisor shall have a minimum of 10 years experience in the HVAC field (and generator field as applicable) and at least 2 years experience in project supervision. The supervisor shall be knowledgeable with all codes and standards relating to the installation, maintenance and repair of HVAC equipment (and generator equipment as applicable). The supervisor must be able to speak, read, write and understand English. The supervisor shall designate one alternate to act in the absence of the supervisor; this alternate must meet the requirements of the supervisor.

1.6.3 Maintenance Mechanics and Technicians

The maintenance mechanics and technicians actually performing the work on the systems and equipment shall be journeymen-level tradesmen with at least 3 years experience in the maintenance and repair of the equipment on which they will be performing work. Journeymen mechanics must possess the necessary licenses required by the state and/or locality in which the work is being performed. The contractor shall submit a resume to the CO for all journeymen mechanics and technicians identifying their experience, training, qualifications, licenses, and certifications and the types of equipment on which they will be working on.

Sub-journeymen level personnel may be used to assist the journeymen workers, and may be used to perform various tasks that normally do not require a journeymen level mechanic.

1.6.4 Security Requirements

Contractor shall comply with all installation security requirements. Contractor personnel shall obtain the required pass and identification items as applicable for contractor personnel and for privately owned vehicles. The contractor shall provide each employee with an identification badge that includes the employee's name, employee's photograph, and the contractor's name.

1.6.5 Building Access

The contractor will not be allocated any keys to the space. The contractor must coordinate with building personnel to gain access to any secured room/area. The contractor shall not leave any locked room/areas unattended or permit entrance by anyone other than their personnel into the space while they are performing duties. Once duties are complete the contractor shall ensure the space is secure and notify Facility Coordinator and/or Facility Management Specialist that they have completed the work within the secured area. All contractor personnel shall follow the established building access procedures.

1.6.6 Environmental Compliance

The contractor shall be knowledgeable of and comply with all applicable Federal, State and local laws, regulations, and requirements regarding environmental protection. The contractor shall ensure policies and procedures are established that protect the health and safety or employees and the community and minimize/eliminate the risk of environmental pollution.

1.6.7 Fire Prevention and Security

Contractor personnel shall follow installation fire prevention and security procedures. The contractor and his employees shall comply with the base fire regulation. Burning of any material by the contractor is prohibited. CO must approve any work that may interfere with fire exit routes and/or exits prior to the start of work. A welding permit must be obtained from the installation Fire Department prior to performing any welding.

1.6.8 Anti-Terrorism Force Protection

Contractor shall become familiar with and follow all requirements of the Department of Defense Minimum Antiterrorism Standards, UFC-4-010-01 for Buildings while on the base. (UFC-4-010-01 may be found at http://www.ccb.org/ufgs/ufgs.htm)

1.6.8.1 Exterior Equipment

At no time shall exterior equipment have panels or louvers removed and left without personnel present.

1.6.8.2 Trash Containers

At no time shall trash containers be moved closer to the building than 10m.

1.6.8.3 Exterior Doors

At no time shall locked exterior doors be held open while personnel are not present.

1.6.8.4 Parking

Parking of contractor vehicles shall only be in the designated parking area, contractor shall not leave any vehicles unattended out of parking area.

1.6.9 Coordination Requirements

The contractor shall fully cooperate with other contractors who may be performing other work in the facilities identified under this contract. Any conflicts between work being performed under this contract and that being performed by other contractors shall be brought to the attention of the CO. The CO shall resolve all work conflicts between this contract and the work of other contractors.

1.7 ITEMS, SERVICES AND EQUIPMENT

1.7.1 Office Area, Storage and Lay-down Areas

There will be no space within the building or on site allocated to the contractor. Any lay-down required during specific duties must be coordinated in advance and approved by the CO.

1.7.2 Computer and Software

A computer, monitor and workstation with PM software shall be furnished and installed under specification section 15951 as part of the controls software. The contractor will have access to the computer in order to utilize the PM software for use controlling and tracking data and information as well as scheduling any other duties related to contract performance. The contractor shall not use the computer equipment and software for non-contractual purposes. The contractor shall comply with all computer system and accountability procedures required by the government. If the contractor chooses to use their own maintenance software they are still required to update and maintain the software provided in SECTION 15951 DIRECT DIGITAL CONTROL FOR HVAC.

1.8 CONTRACTOR FURNISHED ITEMS AND SERVICES

1.8.1 Replacement Parts and Components

The contractor shall furnish and install new or factory reconditioned parts and components when providing scheduled maintenance services.

All replacement parts and components used in the maintenance of the buildings shall be compatible with the existing equipment on which it is to be used. They shall be standard products from manufacturer's regularly engaged in the production of such materials, parts and supplies and shall be of equal or better quality as original equipment specifications. They shall conform to the applicable specifications and be used in accordance with original design and manufacturer intent. Items without technical specifications shall be of acceptable industrial grade and quality. If the original manufacturer has updated the quality of parts for current production, parts supplied under this contract shall equal or exceed the updated quality. Replacement parts material and supplies shall meet current base energy efficiency standards.

1.8.3 Scheduled Maintenance

The contractor shall acquire and bear the cost of all materials, parts and supplies, including filters, necessary to perform scheduled maintenance actions under this contract.

1.8.4 Vehicles

The contractor shall provide and maintain all vehicles necessary to perform the requirements of the contract. Contractor vehicles shall have the company name prominently displayed on both sides of the vehicle and be maintained clean to present a neat, professional appearance. Contractor-owned vehicles shall be parked in authorized parking spaces. All vehicles shall be state-registered, registered on base, licensed, insured, and operated in accordance with base traffic regulations by a valid state-licensed driver.

1.8.5 Communication Services

The use of contractor provided two-way radios/pagers for communication between personnel must be approved by the CO. The contractor shall submit a written request to the CO. The request shall detail proposed manufacturer and frequency.

1.9 PAYMENT

Refer to SECTION 00800

PART 2 SPECIFIC TASKS

2.1 MANAGEMENT AND ADMINISTRATION SUPPORT

2.1.1 Meetings

The supervisor, or approved designated alternate, shall meet with the CO monthly to review project schedules, status and other matters pertaining to the performance of work under this contract.

2.1.2 Environmental Protection

The contractor shall ensure appropriate coordination in the purchase, use, handling, storage and disposal of all hazardous materials and wastes.

2.1.3 Normal Working Hours

The contractor shall perform all work required under this contract during normal duty hours of 8:00am to 4:30pm, Monday through Friday. Any work required to be performed outside of the normal working hours must be submitted and approved by the CO 5 days in advance.

2.2 SAFETY PROGRAM

The contractor shall establish and implement a safety program in accordance with OSHA requirements and EM385-1-1 (EM385-1-1 may be found at http://www.hnd.usace.army.mil/techinfo/ or ask the CO). The contractor shall submit an overall Safety and Health Plan prior to the start of any work under this contract. The overall Safety and Health Plan shall include, as a minimum, the plans listed below. The contractor shall not start any work until the safety plans have been approved by the Government.

Accident Prevention Plan
Hazard Analysis
Lock Out and Tag Plan

2.3 OPERATION AND MAINTENANCE DATA

Operation and Maintenance manuals are to be prepared per SECTION 01800 EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS.

2.4 TRAINING

The maintenance supervisor or his alternate shall be present for all training sessions with the building operating staff for the equipment being installed.

2.5 REPORTING

2.5.1 Maintenance Scheduling

The Project supervisor, or alternate, shall submit a 4-week schedule for all work to the CO for approval. Any changes to the schedule must be approved by the CO. The project supervisor, or alternate, must be on-site whenever work is being performed. Prior to starting work the contractor shall login to the computer identifying the task or tasks being performed. The contractor shall also log-out when leaving the site.

2.5.2 Review of Documents

The contractor shall review and become familiar with all design documents, including drawings and specifications.

2.5.3 PM Schedules and Reports

2.5.3.1 Yearly Master Report

The contractor shall prepare, submit and comply with a written yearly master PM schedule. The contractor shall research equipment manufacturer's and industry recommendations for preventive maintenance requirements and ensure these requirements are included in the Master PM Schedule and 4-week detailed schedule.

2.5.3.2 Monthly Detailed Report

The 4-week schedule shall identify the PM tasks that are scheduled during the specified period. Schedule shall identify the equipment and the task to be performed, the day the task will be performed, the number of personnel required and the estimated duration.

2.5.3.3 Monthly Completion Report

A monthly completed PM report will be submitted every month showing the PM actions completed the past month. PM actions that were scheduled but not completed should be clearly identified. An explanation for those PM actions scheduled but not completed shall be provided.

2.6 PREVENTIVE MAINTENANCE

2.6.1 Preventive Maintenance

The contractor shall obtain all materials necessary and perform the scheduled maintenance tasks on the equipment identified in Appendix A and D

in accordance with the Government-approved, contractor-developed, Master PM schedule.

2.7 UNSCHEDULED MAINTENANCE AND REPAIR

2.7.1 Unscheduled Maintenance Due to Neglect

Any maintenance or repair to equipment required to be done due to equipment neglect shall be done by the contractor without any modifications to the contract price. However, in the event the Contracting Officer determines that the contractor is unresponsive or untimely in addressing the unscheduled maintenance and repair, the Government reserves the right to have said repair performed by a third party with subsequent equitable adjustment in contract price.

2.8 CONTRACTOR CLEAN-UP

The contractor shall, at all times, keep the work areas free from accumulation of waste material, rubbish, tools, scaffolding, equipment, and materials. Upon completion of the task, or nightly, the contractor shall leave the work area and premises in a clean, neat, safe and workmanlike condition. The contractor is responsible for disposing of both hazardous and non-hazardous job-related waste material in accordance with the local installation procedures.

2.9 PREVENTIVE MAINTENANCE SOFTWARE

2.9.1 Updating Software

The contractor shall input all data required to maintain records for existing equipment into the Government's PM software.

The contractor shall maintain an equipment file for each piece of equipment listed in Appendix A, to include:

Contractor furnished O&M manuals
Manufacturer's literature on preventive maintenance
Current warranty information, if applicable
Other literature relevant to the equipment items

This filing shall be maintained offsite since contractor has no allocated space inside buildings.

Changes, additions and deletions of equipment may occur during the term of this contract and may require updates and/or revisions to the equipment inventory and the Master PM Schedule. Changes to the Master PM schedule will be negotiated and may result in a contract modification. The contractor shall advise the CO if any change to the PM schedule will result in substantial change to the contract prior to implementing the change.

It is the responsibility of the contractor to maintain the PM Software database up to date. The building occupants shall have access to the computer software program and can, at any time, print out a review schedule of past maintenance on any piece of equipment or look at future maintenance scheduled to be performed.

APPENDIX A

It shall be the contractor's responsibility to provide preventive maintenance on all equipment listed in Table 1 below. For a detailed PM schedule for the listed equipment refer to Appendix B.

EQUIPMENT TAG	EQUIPMENT NAME	TRAINING BLDG QUANTITY	OMS BUILDING QUANTITY
CH-	AIR COOLED CHILLER	1	-
GFB-	GAS FIRED BOILER	2	-
HWB-	CONDENSING TYPE BOILER	-	1
AHU-	AIR HANDLING UNIT	2	-
FCU-	FAN COIL UNIT	101	-
HV-	HEATING VENTILATING UNIT	-	1
PTAC-	PACKAGED TERMINAL AIR CONDITIONING UNIT	-	2
EF-	EXHAUST FAN	5	8
UH-	HOT WATER UNIT HEATER	10	-
UH-	ELECTRIC UNIT HEATER	-	5
CUH-	HOT WATER CABINET UNIT HEATER	2	-
P-	PUMPS	8	2
L-	LOUVERS /DAMPERS	9	9
AC-	AIR CONDITIONING UNIT	1	-
ACCU-	AIR COOLED CONDENSING UNIT	1	-
AC-	AIR COMPRESSOR	-	1
EWH-	ELECTRIC WATER HEATER	-	1
GWH-	GAS WATER HEATER	2	-
KF-	KITCHEN EXHAUST FAN	3	-
KMAU-	KITCHEN MAKE-UP AIR UNIT	1	-
	OIL/WATER SEPARATOR	-	1
	GAS SUPPLY SYSTEM	1	1
	CHILLED WATER SYSTEM	1	-
	HEATING HOT WATER SYSTEM	1	1
	DOMESTIC WATER SYSTEM	1	1
	SEWER SYSTEM	1	1

Appendix B

The following procedures are to be considered the minimum requirements for preventive maintenance for the equipment in the Training/Unit storage building and the OMS building. In addition, the contractor shall research and schedule any manufacturer's recommended maintenance procedures for each piece of equipment.

GAS SUPPLY SYSTEM

SEMI-ANNUALLY:
1. Inspect gas trains on boilers, hot water heaters and heating ventilating unit for any leaks, repair as required.
2. Inspect main gas riser for leaks, repair as required.

HEATING HOT WATER SUPPLY SYSTEM

QUARTERLY:
1. Inspect piping for corrosion, leaks, damaged or missing supports, and chipped or flaking paint.
2. Check condition of insulation and jacketing, repair any damaged portions.

CHILLED WATER SUPPLY SYSTEM

QUARTERLY:
1. Inspect piping for corrosion, leaks, damaged or missing supports, and chipped or flaking paint.
2. Check condition of insulation and jacketing, repair any damaged portions.

SEWER SYSTEM

SEMI-ANNUALLY:
1. Inspection of the manholes to make sure nothing is clogged up and they are flowing.

AIR COOLER CHILLER (CH-1)

WEEKLY:
1. Check and record evaporator and condenser refrigerant pressures and temperatures.
2. Check liquid line sight glasses.
3. Visually inspect condenser coils and compressors.
4. Check chiller diagnostics.

MONTHLY:
1. Check and record superheat and sub cooling.
2. Manually rotate condenser fans and check clearances.
3. Check gages and thermometers for proper operation, fix any defects.

SEMI-ANNUALLY:
1. Clean coils and straighten any bent fins.

ANNUALLY:
1. Check oil level and refrigerant charge.

2. Have oil analysis performed
3. Leak test chiller
4. Clean any in-line strainers
5. Clean and repaint any areas showing signs of corrosion.
6. Clean condenser fans. Check for alignment, endplay, vibration and noise.
7. Check tightness of electrical connections.

GAS-FIRED BOILER (GFB-)

WEEKLY:
1. Visually check boilers for change in operating condition and unusual noise.

QUARTERLY:
1. Verify operating and safety controls.

SEMI-ANNUALLY:
1. Clean burners and heat exchanger
2. Visually inspect venting system, check all joints and pipe connections for tightness, corrosion or deterioration.
3. Clean screens in the venting air intake system.
4. Visually check main burner flame. Ensure that flame color is indicating normal operation.

CONDENSING TYPE GAS FIRED BOILER (HWB-)

SEMI-ANNUALLY:
1. Inspect diaphragm disk and gaskets for wear, replace as required.

ANNUALLY:
1. Replace sparkplug every 2 years or sooner as required.

AIR HANDLING UNITS (AHU-)

WEEKLY:
1. Visually observe units for changes in operating condition and noise.

MONTHLY:
1. Check filter. Measure pressure drop. Change whenever pressure drop exceeds 1 inch WC
2. Change filter every other month regardless of pressure drop.

QUARTERLY:
1. Lubricate fan bearings.
2. Lubricate motor bearings.
3. Check belt tension and condition. Replace if required.

SEMI-ANNUALLY:
1. Check bearings and motor brackets bolt torque.
2. Check supply fan for signs of excessive heat and vibration.
3. Check alignment of fan and motor sheaves. Adjust if required. Tighten sheave set screws.
4. Inspect and clean drain pans.
5. Check tightness of electrical connections.
6. Clean and dirt build-up on heating and cooling coils.
7. Blow down strainers upstream of chilled water and hot water coils.

8. Check disconnect switches for pitted, worn or burned knife blades and clips.
9. Check motor starters for worn, pitted or burned contacts.

ANNUALLY:
1. Clean fan wheels and fan shaft. Remove any rust and apply a coat of LPS #3 or equivalent.
2. Check damper linkages, set screws and blade adjustment. Clean damper bushings.
3. Clean damper operators and verify operation.
4. Manually rotate fan wheel and check clearances.
5. Check gasketing around doors and dampers.

FAN COIL UNITS (FCU-)

QUARTERLY:
1. Change filters.

ANNUALLY:
1. Check unit for noise and vibration.
2. Check belt condition and tension, adjust or replace as necessary.
3. Clean condensate drain pan.
4. Lubricate fan shaft and motor bearings.
5. Clean coils.
6. Use fin comb to straighten coil fins.
7. Check for leaks on all lines, valves, strainers, coils etc.
8. Clean strainers.
9. Damp wide exterior surface of unit.

HEATING VENTILATING UNIT (HV-)

QUARTERLY:
1. Lubricate as required.
2. Change filters

SEMI-ANNUALLY:
1. Check blower and related components for proper operation.
2. Check for proper operation of supply fan.
3. Check sheave alignment and adjust as required.
4. Check belt tension and condition, replace if required.

PACKAGE TERMINAL AIR CONDITIONING UNITS (PTAC-)

MONTHLY:
1. Check for unusual noise and knocks.
2. Replace filter.

ANNUALLY: Remove unit from the wall to allow for:
1. Cleaning of internals of unit, evaporator, and condenser.
2. Inspect electrical system and tighten any loose connections.
3. If required, add refrigerant.

EXHAUST FANS (EF-)

SEMI-ANNUALLY:
1. Check motor and fan shaft for noise, vibration and overheating.
2. Lubricate fan and motor bearings.

3. Check belts for wear, tension and alignment, adjust as required.
4. Tighten all electrical connections.
5. Confirm operation is in accordance with day/night cycle.

HOT WATER UNIT HEATERS (UH-) & CABINET UNIT HEATERS (CUH-)

ANNUALLY:
1. Clean casing, fan and coil.
2. Clean and adjust heat deflector fins.
3. Check tightness of fan guard, motor frame and fan bolts.
4. Verify fan and heat valve operation.
5. Lubricate fan and motor bearings.
6. Blow down strainer located upstream of hot water control valve.

ELECTRIC UNIT HEATERS (UH-)

ANNUALLY:
1. Clean casing, fan and coil.
2. Check tightness of fan guard, motor frame and fan bolts.

PUMPS

WEEKLY:
1. Visually check pumps for change in operating condition and unusual noise.

SEMI-ANNUALLY:
1. Lubricate as required.
2. Check alignment and seals.
3. Check tightness of electrical connections.
4. Clean or flush suction strainers.

EXPANSION TANK (ET-)

ANNUALLY:
1. Check tank hangers or floor supports for corrosion.
2. Check tank, piping and valves for leaks.
3. Check condition of pressure gage.

AIR SEPARATOR (AS-)

SEMI-ANNUALLY:
1. Inspect air separator and piping for signs of water leakage.
2. Check that air separator bleed valve is free of obstructions and debris.

LOUVERS/DAMPERS

ANNUALLY:
1. Clean out debris and dirt blown against louver.
2. Lubricate damper pivot points.
3. Check operation of motor driven actuator.

AIR CONDITIONING UNIT (AC-)

MONTHLY:
1. Observe condition of refrigerant through sight glass.

2. Observe belt wear and check belt tension.
3. Clean evaporator coil.
4. Clean drip pan and drains.
5. Replace filter.

ANNUALLY:
1. Check that all electrical connections are tight.

AIR COOLED CONDENSING UNIT (ACCU-)

SEMI-ANNUALLY:
1. Clean coil fins.
2. Clean fans.
3. Lubricate fan bearings.
4. Observe belt wear and check belt tension.
5. Remove dust and dirt for exterior of motor.
6. Check hold-down bolts and grounding straps for tightness.
7. Check alignment of motor and fans.

ANNUALLY:
1. Check that all electrical connections are tight.

AIR COMPRESSOR (AC-)

EVERY 2000 HOURS OF OPERATION:
1. Replace air filter.
2. Replace crankcase oil.
3. Inspect electrical connections and voltage.
4. Test tank in accordance with manufacturer's recommendation.
5. Drain tank in accordance with manufacturer's recommendation.

ELECTRIC WATER HEATER (EWH-)

ANNUALLY:
1. Flush the heater and verify thermal expansion protection.

GAS WATER HEATER (GWH-)

WEEKLY:
1. Visually check unit for change in operating condition and unusual noise.

MONTHLY:
1. Adjust operating temperature control as outside air temperature requires.

QUARTERLY:
1. Verify operating and safety controls.

SEMI-ANNUALLY:
1. Clean burners and heat exchanger.
2. Visually inspect venting system, check all joints and pipe connections for tightness, corrosion or deterioration.
3. Clean screens in the venting air intake system.
4. Visually check main burner flame. Ensure that flame color is indicating normal operation.

KITCHEN EXHAUST FAN AND HOOD (KEF-)

SEMI-ANNUALLY:
1. Check and clean grease off of duct interiors at connection to the hood.
2. Check and clean grease from duct interiors at access panels.
3. Check access panels for tight seal to prevent air leaks and for grease leaks.
4. Check and clean grease from all visible and accessible duct seams or joints.
5. Check hood exhaust fans for grease including exterior surfaces, fan housing, blades and protective grilles and screens. Clean as required.
6. Check and clean building surfaces at the discharge end of the exhaust fan housing.
7. Check fan belts for wear and tension and alignment, adjust as required.

KITCHEN MAKEUP AIR UNIT (KMAU-)

MONTHLY:
1. Visually inspect unit for changes in operating condition and unusual noise.

SEMI-ANNUALLY:
1. Wash filters.
2. Check blower and related components for proper operation.
3. Check sheave alignment and adjust if required.
4. Check belt tension and condition, replace if required.
5. Check discharge air temperature.

OIL/WATER SEPARATOR

QUARTERLY:
1. Inspect to check for build-up of sand, trash, sludge and oil.

SEMI-ANNUALLY:
1. Clean inside of separator.

APPENDIX C

It shall be the contractor's responsibility to provide preventive maintenance on all equipment listed in Table 1 below. For a detailed PM schedule for the listed equipment refer to Appendix D.

Equipment Name
Generator Engine
Fuel Pumps
Batteries
Battery Chargers
Fuel Storage Tanks
Drive Belts
Engine Heater
Engine Exhaust
Engine Silencer
Generator Set Controller
Alternator
Gauges
Air Cleaner
Oil Filter
Fuel Filter
Cooling System
Enclosure
Starter
Fuel Lines

APPENDIX D

The following procedures are to be considered the minimum requirements for preventive maintenance for the generator and its components. In addition, the contractor shall research and schedule any manufacturer's recommended procedures. All service adjustments will be made in accordance with manufacturer's specifications using required tools and procedures.

Oil System

Annually:
1. Change oil and filter.

Semi-Annually:
1. Check entire unit for oil leaks.
2. Check lube oil level.
3. Take oil sample.

Fuel System

Annually:
1. Change fuel filters and clean fuel bowl, if applicable.

Semi-Annually:
1. Check flexible fuel connections and lines.
2. Check day tank float level.
3. Check fuel filter(s) for debris.
4. Check and record fuel supply.
5. Service transfers of day tank pump motor.
6. Check and adjust float switch alarm.
7. Check drain operation.

Cooling System

Semi-Annually:
1. Check cooling system for leaks.
2. Record antifreeze protection level and change if necessary.
3. Record DCA treatment level.
4. Check condition of cooling hoses and tighten clamps.
5. Check engine block heater for proper operation.
6. Change water filters.

Air System

Semi-Annually:
1. Check hoses, clamps, and louvers.
2. Clean air filter.
3. Remove dust from dry-type filter.
4. Refill oil from wet-type filter.
5. Check air restriction indicator.

Exhaust System

Semi-Annually:
1. Visual inspection of exhaust system.
2. Check for exhaust leaks.

Batteries

Semi-Annually:
1. Check battery starting system.
2. Check battery charger and record readings.
3. Check solution level.
4. Check connections and clean.
5. Check battery cranking voltage.
6. Note overall condition of battery system.

Electrical

Semi-Annually:
1. Check electrical connections.
2. Check AC and DC brushes.
3. Check collector ring.
4. Check commutator.
5. Free and seat brushes and check shunts, stone and clean if needed.
6. Lubricate main generator bearing.

Hoses/Belts

Semi-Annually:
1. Check all hoses for proper pliability.
2. Check hard plumbing for problems including tank cap, cones, and air vent.
3. Check and adjust belts and/or replace if required.

Engine

Semi-Annually:
1. Check turbo chargers bearing clearance.
2. Remove carbon build up from turbo charger.
3. Check injection pump.
4. Change governor oil.
5. Lubricate starter bendix, generator-alternator, water pump, and governor and linkage.

Operating Check

Semi-Annually:
<u>Run Generator Under Load to:</u>
1. Check for leaks.
2. Check voltage.
3. Check frequency.
4. Check all instrumentation.
5. Check condition of trickle charge.
6. Check alternator charge rate.
7. Conduct safety test for:
   a) Overspeed.
   b) Low oil pressure.
   c) High water temperature.
8. Record all engine gauge and meter readings.
9. Record all transfer switch readings and adjustment.
10. Return system to auto start.

Report:
Furnish a written report of the service performed to the Owner after each inspection. The report may include recommendations and suggestions based on the observation of the service technicians during the inspections.

Observation of the service technicians during the inspections.
-- End of Section --

SECTION 16263A

GENERATOR OPTION
DIESEL-GENERATOR SET STATIONARY 100-2500 KW, WITH AUXILIARIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 181/A 181M	(2000) Carbon Steel Forgings for General-Purpose Piping
ASTM A 234/A 234M	(2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM D 975	(1998b) Diesel Fuel Oils

ASME INTERNATIONAL (ASME)

ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995a) Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C57.13.1	(1981; R 1992) IEEE Guide for Field Testing of Relaying Current Transformers
IEEE Std 1	(1986; R 1992) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE Std 43	(1974; R 1991) Testing Insulation Resistance of Rotating Machinery
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 115	(1995) IEEE Guide: Test Procedures for Synchronous Machines
IEEE Std 120	(1989) Electrical Measurements in Power Circuits
IEEE Std 484	(1996) Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std 485	(1997) Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
IEEE Std 519	(1992) Harmonic Control in Electrical Power systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA MG 1	(1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996; Errata; TIA 96-2) Flammable and Combustible Liquids Code
NFPA 37	(1998) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2002) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J 537	(1996) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 1236	(1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout; G, RE
General Installation; G, RE

Drawings shall include the following:

a. Base-mounted equipment, complete with base and attachments, including anchor bolt template and recommended clearances for maintenance and operation.

b. Complete starting system.

c. Complete fuel system.

d. Complete cooling system.

e. Complete exhaust system.

f. Layout of relays, breakers, programmable controllers, and switches including applicable single line and wiring diagrams with written description of sequence of operation and the instrumentation provided.

g. The complete lubrication system, including piping, pumps, strainers, filters, controls and wiring.

h. Location, type, and description of vibration isolation devices for all applications.

i. The safety system, together with a detailed description of how it is to work. Wiring schematics, safety devices with a listing of their normal ranges, alarm and shutdown values (to include operation parameters such as pressures, temperatures voltages, currents, and speeds) shall be included.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and instrumentation.

k. Layout of each panel.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set lifting points and rigging instructions.

Acceptance; G, RE

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation. Layout drawings shall be revised to reflect the as-built conditions and shall be submitted with the as-built drawings.

SD-03 Product Data

Performance Criteria; G, RE

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Limitations; G, RE

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Harmonic Requiremants; G, RE
Engine-Generator Parameter Schedule; G, RE

Description of the generator features which mitigate the effects of the non-linear loads listed.

Integral Main Fuel Storage Tank; G, RE
Day Tank; G, RE

Calculations for the capacity of each day tank, including allowances for recirculated fuel, usable tank capacity, and duration of fuel supply.

Power Factor; G, RE

The generator capability curve showing generator kVA output capability (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Heat Rejected To Engine-Generator Space; G, RE

Manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

Cooling System; G, RE

A letter which certifies that the engine-generator set and cooling system function properly in the ambient temperature specified.

a. The maximum allowable inlet temperature of the coolant fluid.

b. The minimum allowable inlet temperature of the coolant fluid.

c. The maximum allowable temperature rise in the coolant fluid through the engine.

Time-Delay on Alarms; G, RE

The magnitude of monitored values which define alarm or action set points, and the tolerance (plus and/or minus) at which the devices activate the alarm or action for items contained within the alarm panels.

Generator; G, RE

Manufacturer's standard data for each generator (prototype data at the specified rating or above is acceptable), listing the following information:

Direct-Axis subtransient reactance (per unit).

The generator kW rating and short circuit current capacity (both symmetric and asymmetric)

Manufacturer's Catalog; G, RE

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate complete specification compliance.

Site Welding; G, RE

A copy of qualifying procedures and a list of names and identification symbols of qualified welders and welding operators.

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their identification symbols.

Spare Parts; G, RE

A complete list of spare parts for each piece of equipment and a complete list of all material and supplies needed for continued operation. Lists shall include supply source and current prices. Each list shall be separated into two parts, those elements recommended by the manufacturer to be replaced after 3 years of service, and the remaining elements.

Onsite Training; G, RE

A letter giving the date proposed for conducting the onsite training course, the agenda of instruction, a description of the video taping service to be provided, and the kind and quality of the tape to be left with the Contracting Officer at the end of the instructional period.

Battery Charger; G, RE

Battery charger sizing calculations.

Vibration-Isolation; G, RE

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

Posted Data and Instructions; G, RE

Posted data including wiring and control diagrams showing the key mechanical and electrical control elements, and a complete layout of the entire system.

Instructions; G, RE

Instructions including: the manufacturers pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks,

procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, and posted where directed.

Experience; G, RE

Each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

Field Engineer; G, RE

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

General Installation; G, RE

A copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure.

SD-06 Test Reports

Factory Inspection and Tests; G, RE

Six complete reproducible copies of the factory inspection result on the checklist format specified in paragraph FACTORY INSPECTION AND TESTS.

Factory Tests; G, RE

a. A letter giving notice of the proposed dates of factory inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the manufacturer's procedures for factory tests at least 14 days prior to beginning tests.

c. Six copies of the Factory Test data described below in 215.9 x 279.4 mm (8-1/2 x 11 inch) binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. Data plots shall be full size (215.9 x 279.4 mm (8-1/2 x 11 inch) minimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for factory tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

Onsite Inspection and Tests; G, RE

a. A letter giving notice of the proposed dates of onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's procedures for onsite tests including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 14 days prior to beginning tests.

c. Six copies of the onsite test data described below in 215.9 x 279.4 mm (8-1/2 x 11 inch) binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. Data plots shall be full size (215.9 x 279.4 mm (8-1/2 x 11 inch) minimum), showing grid lines, with full resolution.

(1) A detailed description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

SD-07 Certificates

Vibration Isolation; G, RE

Torsional analysis including prototype testing or and calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, ± 10%.

Prototype Test; G, RE

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability; G, RE

A reliability and durability certification letter from the manufacturer and assembler to prove that existing facilities are and have been successfully utilizing the same components proposed to meet this specification, in similar service. Certification may be based on components, i.e. engines used with different models of generators and generators used with different engines, and does not exclude annual technological improvements made by a manufacturer in the basic standard-model component on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets the performance requirements specified. Provide a list with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions; G, RE

A certification from the engine manufacturer stating that the engine exhaust emissions meet the federal, state, and local regulations and restrictions specified. At a minimum this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HPAs).

Sound Limitations; G, RE

A certification from the manufacturer stating that the sound emissions meet the specification.

Site Visit; G, RE

A letter stating the date the site was visited and listing discrepancies found.

Flywheel Balance; G, RE

A certification stating that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Materials and Equipment; G, RE

A certification stating that where materials or equipment are specified to comply with requirements of UL, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Inspections; G, RE

A letter certifying that all facilities are complete and functional; that each system is fully functional; and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

Cooling System; G, RE

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G, RE

Six copies of the operation manual (approved prior to commencing onsite tests) in 215.9 x 279.4 mm (8-1/2 x 11 inch) binders, having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each system or subsystem. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 215.9 x 279.4 mm (8-1/2 x 11 inch) plastic pockets with reinforced holes. One full size reproducible mylar of each drawing shall accompany the booklets. Mylars shall be rolled and placed in a heavy cardboard tube with threaded caps on each end. The manual shall include: step-by-step procedures for system startup, operation, and shutdown; drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems together with their controls, alarms, and safety systems; the manufacturer's name, model number, and a description of equipment in the system. Each booklet shall include a CDROM containing an ASCII file of the procedures.

Maintenance Procedures; G, RE

Six copies of the maintenance manual containing the information described below in 215.9 x 279.4 mm (8-1/2 x 11 inch) binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each item listed. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes.

a. Procedures for each routine maintenance item.

Procedures for troubleshooting.

Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. A copy of the posted instructions.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components specified for nameplates.

Six complete reproducible copies of the final relay and protective device settings. The settings shall be recorded with the name of the company and individual responsible for their accuracy.

Special Tools; G, RE

Two complete sets of special tools required for maintenance (except for electronic governor handset). Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. The tools shall be supplied complete with a suitable tool box. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings.

Filters; G, RE

Two complete sets of filters, required for maintenance, shall be supplied in a suitable storage box. These filters shall be in addition to filters replaced after testing.

1.3 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set shall satisfy the requirements specified in the Engine-Generator Parameter Schedule.

1.3.1 Engine-Generator Parameter Schedule

ENGINE-GENERATOR PARAMETER SCHEDULE

Power Rating	Standby
Overload Capacity (Prime applications only)	110% of Service Load for 1 hour in 12 consecutive hours
Service Load	1000 kVA (maximum)

ENGINE-GENERATOR PARAMETER SCHEDULE

Motor Starting kVA (Max.)	110 kVA
Power Factor	0.8 lagging
Engine-Generator Applications	stand-alone
Maximum Speed	1800 rpm
Heat Exchanger Type	fin-tube (radiator)
Governor Type	Droop
Frequency Regulation (droop) (No Load to Full Load)	3 % (maximum)
Frequency Bandwidth (steady state)	± 0.4%
Voltage Regulation (No Load to Full Load) (Stand alone applications)	± 2% (maximum)
Voltage Bandwidth (steady state)	± 2%
Frequency	60 Hz
Voltage	480 volts
Phases	3 Phase, Wye
Minimum Generator Subtransient Reactance	12 %
Nonlinear Loads	110 kVA
Max Step Load Increase	50% of Service Load at .8 PF
Transient Recovery Time with Step Load Increase (Voltage)	Per NEMA's recommendation
Transient Recovery Time with Step Load Increase (Frequency)	Per NEMA's recommendation
Maximum Voltage Deviation with Step Load Increase	5% of rated voltage
Maximum Frequency Deviation with Step Load Increase	5% of rated frequency
Max Step Load Decrease	100 % of Service Load at

ENGINE-GENERATOR PARAMETER SCHEDULE

(without shutdown)	.8 PF
Max Time to Start and be Ready to Assume Load	10 seconds
Max Summer Indoor Temp (Prior to Genset Operation)	25.6 degrees C
Min Winter Indoor Temp (Prior to Genset Operation)	20 degrees C
Max Summer Outdoor Temp (Ambient)	31.7 degrees C
Min Winter Outdoor Temp (Ambient)	-5.5 degrees C
Installation Elevation	117 M above sea level

1.3.2 Rated Output Capacity

Each engine-generator-set shall provide power equal to the sum of Service Load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.3.3 Power Ratings

Power ratings shall be in accordance with EGSA 101P.

1.3.4 Transient Response

The engine-generator set governor and voltage regulator shall cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine-generator set shall respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

1.3.5 Reliability and Durability

Each standby engine-generator set shall have both an engine and a generator capable of delivering the specified power on a standby basis with an anticipated mean time between overhauls of no less than 5,000 hours operating with a load factor of 70%. Two like engines and two like generators shall be cited that have performed satisfactorily in a stationary power plant, independent and separate from the physical location of the manufacturer's and assembler's facilities, for standby without any failure to start, including all periodic exercise. Each like engine and generator shall have had no failures resulting in downtime for repairs in

excess of 72 hours during two consecutive years of service. Like engines shall be of the same model, speed, bore, stroke, number and configuration of cylinders, and rated output capacity. Like generators shall be of the same model, speed, pitch, cooling, exciter, voltage regulator and rated output capacity.

1.4 GENERAL REQUIREMENTS

1.4.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and other necessary ancillary equipment which may be mounted separately. Sets having a capacity of 750 kW or smaller shall be assembled and attached to the base prior to shipping. Sets over 750 kW capacity may be shipped in sections. Each set component shall be environmentally suitable for the location shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Any nonstandard products or components and the reason for their use shall be specifically identified in paragraph SUBMITTALS.

1.4.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number and rating on a plate secured to the equipment. As a minimum, nameplates shall be provided for:

Engines	Relays
Generators	
Regulators	Day tanks
Pumps and pump motors	Governors
Generator Breaker	Air Starting System
Economizers	Heat exchangers (other than base mounted)

Where the following equipment is not provided as a standard component by the diesel engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Exhaust mufflers	Exciters
Silencers	
Battery	

1.4.3 Personnel Safety Devices

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.4.4 Verification of Dimensions

Before performing any work, the premises shall be visited and all details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies.

1.4.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, NEMA, etc., the design, fabrication and installation shall also conform to the code.

1.4.6 Site Welding

Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL. For all other welding, procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.

1.4.7 NOT USED

1.4.8 NOT USED

1.4.9 Engine-Generator Set Enclosure

The engine-generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at Service Load under secured conditions. Doors shall be provided for access to controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than the exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

1.4.10 Vibration Limitation

The maximum engine-generator set vibration in the horizontal, vertical, and axial directions shall be limited to 0.15 mm (peak-peak RMS), with an overall velocity limit of 24 mm/second RMS, for all speeds through 110% of rated speed.

1.4.11 Vibration Isolation

The engine-generator set shall be provided with a vibration-isolation system in accordance with the manufacturer's standard recommendation. Vibration-isolation systems shall be designed and qualified (as an integral part of the base and mounting system in accordance with the seismic

parameters specified. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, seismic restraints shall be provided in accordance with the seismic parameters specified.

1.4.12 NOT USED

1.4.13 NOT USED

1.4.14 NOT USED

1.4.15 Harmonic Requirements

Non-linear loads to be served by each engine-generator set are as indicated. The maximum linear load demand (kVA @ PF) when non-linear loads will also be in use is as indicated.

1.4.16 Starting Time Requirements

Upon receipt of a signal to start, each engine generator set will start, reach rated frequency and voltage and be ready to assume load within the time specified. For standby sets used in emergency power applications, each engine generator set will start, reach rated frequency and voltage, and power will be supplied to the load terminals of the automatic transfer switch within the starting time specified.

1.4.17 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

1.4.18 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine generator manufacturer's training courses on installation and operation and maintenance of engine generator sets.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment, in accordance with the manufacturers recommended storage procedures,before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Filter Elements

Fuel-oil, lubricating-oil, and combustion-air filter elements shall be manufacturer's standard.

2.1.2 NOT USED

2.1.3 NOT USED

2.1.4 Pipe (Sleeves, Fuel/Lube-Oil, Compressed Air, Coolant, and Exhaust)

ASTM A 53/A 53M, or ASTM A 106 steel pipe. Pipe smaller than 50 mm (2 inches) shall be Schedule 80. Pipe 50 mm (2 inches) and larger shall be Schedule 40.

a. Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150 or ASME B16.11, 1360.7 kg (3000 lb).

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturer's standard.

2.1.5 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.6 Electrical Enclosures

NEMA ICS 6.

2.1.7 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings and a maximum speed of 1800 rpm. Motors used indoors shall have drip-proof frames; those used outside shall be totally enclosed. Alternating current motors larger than 373 W (1/2 Hp) shall be of the squirrel-cage induction type for operation on 208 volts or higher, 50 Hz, and three-phase power. Alternating current motors 373 W (1/2 Hp) or smaller, shall be suitable for operation on 120 volts, 50 Hz, and single-phase power.

2.1.8 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel fuel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, supercharged, or turbocharged. The engine shall be 2- or 4-stroke-cycle and compression-ignition type. The engine shall be vertical in-line, V- or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have not less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The entire fuel system for each engine-generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

2.3.1.2 Auxiliary Fuel Pump

Auxiliary fuel pumps shall be provided to maintain the required engine fuel pressure, if either required by the installation or indicated on the drawings. The auxiliary pump shall be driven by a dc electric motor powered by the starting/station batteries. The auxiliary pump shall be automatically actuated by a pressure-detecting device.

2.3.2 Fuel Filter

A minimum of one full-flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Integral Main Fuel Storage Tank

Each engine shall be provided with an integral main fuel tank. Each tank shall be factory installed and provided as an integral part of the diesel generator manufacturer's product. Each tank shall be provided with

connections for fuel supply line, fuel return line, local fuel fill port, gauge, vent line, and float switch assembly. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the tank shall be below the flash point of the fuel. Each engine-generator set provided with weatherproof enclosures shall have its tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.3.4.1 Capacity

Each tank shall have capacity to supply fuel to the engine for an uninterrupted 24-hour period at 100% rated load without being refilled.

2.3.4.2 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.4.3 Fuel Level Controls

a. Each tank shall have a float-switch assembly to perform the following functions:

(1) Activate the "Low Fuel Level" alarm at 70% of the rated tank capacity.

(2) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank capacity.

2.3.4.4 Arrangement

Integral tanks may allow gravity flow into the engine. Gravity flow tanks and any tank that allows a fuel level above the fuel injectors shall be provided with an internal or external factory installed valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The fuel supply line from the tank to the manufacturer's standard engine connection shall be welded pipe.

2.3.5 Day Tank

Each engine shall be provided with integral day tank. Each day tank shall be provided with connections for fuel supply line, fuel return line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the day tank shall be below the flash point of the fuel. A temperature sensing device shall be installed in the fuel supply line. Each engine-generator set provided with weatherproof enclosures shall have its day tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.3.5.1 NOT USED

2.3.5.2 Capacity, Standby

Each day tank shall have capacity to supply fuel to the engine for an uninterrupted 4-hour period at 100% rated load without being refilled, plus any fuel which may be returned to the main fuel storage tank. The calculation of the capacity of each day tank shall incorporate the requirement to stop the supply of fuel into the day tank at 90% of the ultimate volume of the tank.

2.3.5.3 Drain Line

Each day tank drain line shall be accessible and equipped with a shutoff valve. Self-supporting day tanks shall be arranged to allow drainage into a 305 mm (12 inch) tall bucket.

2.3.5.4 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.5.5 Fuel Level Controls

a. Each day tank shall have a float-switch assembly to perform the following functions:

(1) When the main storage tank is located higher than the day tank, open the solenoid valve located on the fuel supply line entering the day tank and start the supply of fuel into the day tank. Start the supply of fuel into the day tank when the fuel level is at the "Low" level mark, 75% of the rated tank capacity.

(2) When the main storage tank is located higher than the day tank, stop the supply of fuel into the day tank and close the solenoid valve located on the fuel supply line entering the day tank. Stop the supply of fuel into the day tank when the fuel level is at 90% of the rated tank capacity.

(3) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank capacity.

(4) Activate the "Low Fuel Level" alarm at 70% of the rated tank capacity.

(5) Activate the automatic fuel supply shut-off valve located on the fill line of the day tank and shut down the fuel pump which supplies fuel to the day tank at 95% of the rated tank capacity. The flow of fuel shall be stopped before any fuel can be forced into the fuel overflow line.

2.3.5.6 Arrangement

Integral day tanks may allow gravity flow into the engine. Gravity flow

tanks shall be provided with an internal or external valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The overflow connection and the fuel supply line for integral day tanks which do not rely upon gravity flow shall be arranged so that the highest possible fuel level is below the fuel injectors. When the main fuel storage tanks are located below the day tank, a check valve shall be provided in the fuel supply line entering the day tank. When the main fuel storage tanks are located above the day tank, a solenoid valve shall be installed in the fuel supply line entering the day tank. The solenoid valve shall be in addition to the automatic fuel shut off valve. The fuel supply line from the day tank to the manufacturer's standard engine connection shall be welded pipe.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven pumps. System pressure shall be regulated as recommended by the engine manufacturer. A pressure relief valve shall be provided on the crankcase for closed systems. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Lube-Oil Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.4.3 Precirculation Pump

A motor-driven precirculation pump powered by the station battery, complete with motor starter shall be provided if recommended by the engine manufacturer.

2.5 COOLING SYSTEM

Each engine shall have its own cooling system. Each system shall operate automatically while its engine is running. The cooling system coolant shall use a combination of water and ethylene-glycol sufficient for freeze

protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across each engine shall not exceed that recommended and submitted in paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers. Raw-water circulating pump shall be controlled by manual-off-automatic controllers and shall be electric motor or engine driven.

2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film, provided that correction measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via over sizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 48 kPa (7 psi) and shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes; one tapped hole shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 NOT USED

2.5.4 Thermostatic Control Valve

A modulating type, thermostatic control valve shall be provided in the coolant system to maintain the coolant temperature range submitted in paragraph SUBMITTALS.

2.5.5 Ductwork

Ductwork shall be as specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM except that a flexible connection shall be used to connect the duct to the diesel engine radiator. Material for the connection shall be wire-reinforced glass. The connection shall be rendered as airtight as possible.

2.5.6 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 NOT USED

2.7 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake so that the indicated pressure levels specified in paragraph SOUND LIMITATIONS will not be exceeded. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be copper or rubber.

2.8 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported to minimize vibration. Where a V-type engine is provided, a V-type connector, with necessary flexible sections and hardware, shall connect the engine exhaust outlets.

2.8.1 Flexible Sections and Expansion Joints

A flexible section shall be provided at each engine and an expansion joint at each muffler. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.8.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.8.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a drip leg for collection of condensate with drain valve and

cap. Changes in direction shall be long radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity-operated, self-closing, rain cover.

2.9 PYROMETER

A pyrometer, multi-point selector switch, and thermocouple with calibrated leads shall be provided to show the temperature in each engine cylinder and the combined exhaust. For a supercharged engine, additional points, thermocouples and leads shall be provided to show the temperature in the turbocharger exhaust gas outlet and combustion air discharge passages. Graduated scale length shall be not less than 150 mm. The selector switch shall be double pole, with an "off" position, one set of points for each thermocouple, and suitable indicating dial. The pyrometer, thermocouples, leads and compensating devices shall be calibrated to show true exhaust temperature within plus or minus 1% above the highest temperature encountered at 110% load conditions.

2.10 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.

2.11 STARTING SYSTEM

The starting system for engine generator sets used in non-emergency applications shall be as follows.

2.11.1 Controls

An engine control switch shall be provided with functions including: run/start(manual), off/reset, and, automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cooldown operation. The logic shall be arranged for manual starting. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.11.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15 second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.11.3 Electrical Starting

Manufacturers recommended dc system, utilizing a negative circuit ground.

2.11.3.1 Battery

A starting battery system shall be provided and shall include the battery,

battery rack, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering and relaying. The battery shall be in accordance with SAE J 537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. The battery shall be nickel-cadmium, with sufficient capacity, at the minimum outdoor and maximum outdoor temperature specified, to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

2.11.3.2 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize-charging rate for recharging fully depleted batteries within 24 hours and a floating charge rate for maintaining the batteries at fully charged condition. An ammeter shall be provided to indicate charging rate. A voltmeter shall be provided to indicate charging voltage. A timer shall be provided for the equalize-charging-rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.11.4 NOT USED

2.11.5 Starting Aids

The manufacturer shall provide one or more of other following methods to assist engine starting.

2.11.5.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of minus 32 degrees C (minus 25 degrees F).

2.11.5.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 1.7 degrees C (3 degrees F) of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. Power for the heaters shall be 120 volts ac.

b. Standby Rated Sets

The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified at the minimum winter outdoor temperature.

2.11.5.3 Lubricating-Oil Heaters

A thermostatically controlled electric heater shall be mounted in the engine lubricating-oil system to automatically maintain the oil temperature within plus or minus 1.7 degrees C (3 degrees F) of the control

temperature. The heater shall operate independently of engine operation so that starting times are minimized. Power for the heaters shall be 16 volts ac.

2.12 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110% of the rated speed/frequency, over a steady state load range of 0 to 100% or rated capacity.

2.12.1 Governor Performance

Droop governors shall maintain the midpoint of the frequency bandwidth linearly for steady-state loads over the range of zero to 100% of rated output capacity, configured for safe, manual, external adjustment of the droop from zero to 7 %.

2.13 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25% overspeeds, or voltages and temperatures at a rated output capacity of 110% for prime applications and 100% for standby applications. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.13.1 Current Balance

At 100% rated output capacity, and load impedance equal for each of the 3 phases, the permissible current difference between any 2 phases shall not exceed 2% of the largest current on either of the 2 phases.

2.13.2 Voltage Balance

At any balanced load between 75 and 100% of rated output capacity, the difference in line-to-neutral voltage among the 3 phases shall not exceed 1% of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25% load at unity power factor placed between any phase and neutral with no load on the other 2 phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3% of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25% load for single phase load conditions means 25% of rated current at rated phase voltage and unity power factor.

2.13.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced rated output capacity shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% of the fundamental at rated output capacity. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.14 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 4O degrees C ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.15 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine-generator voltage output without special tools, during operation, from 90 to 110% of the rated voltage over the steady state load range of 0 to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 20 degrees C. Reactive droop compensation or reactive differential compensation shall load share the reactive load proportionally between sets during parallel operation.

2.15.1 Steady State Performance (Regulation or Voltage Droop)

The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.16 GENERATOR ISOLATION AND PROTECTION

Devices necessary for electrical protection and isolation of each engine-generator set and its ancillary equipment shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit withstand, and interrupting current ratings to match the generator capacity. A set of surge capacitors, to be mounted at the generator terminals shall be provided. Monitoring and control devices shall be as specified in paragraph GENERATOR PANEL.

2.17 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc. shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals

shall have manual acknowledgment and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.17.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 3.1 m. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.17.2 Visual Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously lit upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.17.3 Alarms and Action Logic

2.17.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

2.17.3.2 Problem

Activation of the visual signal shall be accomplished.

2.17.4 Local Alarm Panel

A local alarm panel shall be provided with the following shutdown and alarm functions as indicated and including the listed Corps of Engineer requirements mounted either on or adjacent to the engine generator set.

Device/Condition /Function	What/Where/Size	Function Required
Shutdowns w/Alarms		
High engine temperature	Automatic/jacket/ water/cylinder	SD VA
Low lube-oil pressure	Automatic/pressure/ level	SD VA
Overspeed Shutdown& Alarm	(110 percent (± 2 % of rated speed)	SD VA

Device/Condition /Function	What/Where/Size	Function Required
Overcrank, Failure to start	Automatic/Failure to start when used	
Air shutdown damper (200-600kW)	When Used	
Day tank overfill limit indication & transfer pump shutdown (95 % volume)	Automatic/Day Tank/Level	SD(Pump) CP VA
Red emergency stop switch	Manual Switch	SD VA
Alarms		
Day Tank integral main fuel storage tank (Low fuel Limit indication) (70 percent volume remaining)	Automatic/Day Tank Level	CP VA
Low fuel level	Main tank, 3 hrs remaining	CP VA
Integral Main Fuel Storage Tank High Fuel Level	95% volume	CP VA
Low Coolant Temperature	jacket water	CP VA
Pre-High Temperature	jacket water/ cylinder	CP VA
Pre-Low Lube-oil Pressure		CP VA
High battery Voltage		

Device/Condition /Function	What/Where/Size	Function Required
Low battery Voltage		
Battery charger AC Failure	AC supply not available	
Control switch not in AUTO		
Low starting Air pressure		
Low starting hydraulic pressure		

SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional

2.17.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.18 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc. shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.18.1 Controls

A local control panel shall be provided with controls as indicated mounted either on or adjacent to the engine generator set.

Device/Condition/ Function	Function Required
Controls	
Switch: run/start - off/reset - auto	CP/RB
Emergency stop switch & alarm	CP
Lamp test/indicator	CP

Device/Condition/ Function	Function Required
test	
Common alarm contacts/ fault relay	
Panel lighting	CP
Audible alarm & silencing/reset switch	CP
Voltage adjust for voltage regulator	CP
Pyrometer display w/selector switch	CP
Remote emergency stop switch	
Remote fuel shutoff switch	
Remote lube-oil shutoff switch	

2.18.2 Engine Generator Set Metering and Status Indication

A local panel shall be provided with devices as indicated mounted either on or adjacent to the engine generator set.

Device/Condition/ Function	Function Required
Genset Status & Metering	
Genset supplying load	VA
System ready	
Engine oil pressure	CP
Engine coolant temperature	CP
Engine RPM (tachometer)	CP
Engine run hours	CP
Pyrometer display w/selector switch	CP
AC volts (generator), 3-phase	CP
AC amps (generator), 3 - phase	CP
Generator Frequency	CP
Phase selector switches (amps & volts)	CP
Watts/kW	VA
Voltage Regulator Adjustment	CP

X - Required

CP - On Control Panel

Device/Condition/ Function
Function Required
VA - Visual Alarm
AA - Audible Alarm
RB - Remote in Building (Electrical Room)

2.19 NOT USED

2.20 PANELS

Each panel shall be of the type and kind necessary to provide specified functions. Panels shall be mounted on the engine-generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush. Convenient access to the back of panels shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Switch plates shall clearly identify the switch-position function.

2.20.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6. Locking mechanisms shall be keyed alike.

2.20.2 NOT USED

2.20.3 Electronic

Electronic indicating instruments shall be true RMS indicating instruments, 100% solid state, state-of-the-art, microprocessor controlled to provide specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 98% for unit mounted devices and 99% for control room, panel mounted devices, throughout a temperature range of minus 20 to plus 65 degrees C. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 13 mm.

2.20.4 Parameter Display

Indication or readouts of the tachometer, lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and safety system parameters shall be provided. A momentary switch shall be specified for other panels.

2.21 NOT USED

2.22 MANUAL ENGINE-GENERATOR-SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set, and synchronization of each set with an energized bus.

2.23 STATION BATTERY SYSTEM

A station battery system shall be provided to include the battery, battery rack, spacers, automatic battery charger and distribution panelboard with overcurrent protection, metering and relaying. Components shall be sized to withstand the seismic acceleration forces specified. The batteries shall have a rated life of 20 years and a manufacturer's 5-year, no cost replacement guarantee.

2.23.1 Battery

The battery shall be nickel-cadmium, sized in accordance with IEEE Std 485 and conform to the requirements of IEEE Std 484. Valve-regulated lead-acid batteries are not acceptable.

2.23.2 Battery Capacity

The battery shall have sufficient capacity to serve the following loads without recharging.

a. Diesel-generator safety circuits.

2.23.3 Battery Charger

A current-limiting, battery charger shall be furnished to automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted batteries within 8 hours which is continuously adjustable and a floating-charge rate for maintaining the batteries in a fully charged condition. The charger shall be equipped with a low-voltage alarm relay, 0- to 24-hour equalizing timer, an ammeter to indicate charging rate, and necessary circuit breakers. The charger shall conform to the requirements of UL 1236. A battery is considered to be fully depleted when the voltage falls to a level incapable of operating the equipment loads served by the battery.

2.24 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall withstand and mitigate the affects of synchronous vibration of the engine and generator. The base shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.25 THERMAL INSULATION

Thermal insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.26 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.27 FACTORY INSPECTION AND TESTS

The factory tests shall be performed on each engine-generator set. The component manufacturer's production line test is acceptable as noted. Each engine-generator set shall be run not less than 1 hour at rated output capacity prior to inspections. Inspections shall be completed and all necessary repairs made, prior to testing. Engine generator controls and protective devices that are provided by the generator set manufacturer as part of the standard package shall be used for factory tests. When controls and switchgear are not provided as part of the generator set manufacturer's standard package, the actual controls and protective devices provided for the project are not required to be used during the factory test. The Contracting Officer may provide one or more representatives to witness inspections and tests.

2.27.1 Factory Inspection

Inspections shall be performed prior to beginning and after completion of testing of the assembled engine-generator set. Inspectors shall look for leaks, looseness, defects in components, proper assembly, etc. and any item found to be in need of correction shall be noted as a necessary repair. The following checklist shall be used for the inspection:

INSPECTION ITEM	GOOD	BAD	NOTES
1. Drive belts			
2. Governor and adjustments			
3. Engine timing mark			
4. Starting motor			
5. Starting aids			
6. Coolant type and concentration			
7. Radiator drains			
8. Block coolant drains			
9. Coolant fill level			
10. All coolant line connections			
11. All coolant hoses			
12. Combustion air filter			
13. Combustion air silencer			
14. Lube oil type			
15. Lube oil sump drain			
16. Lube-oil filter			
17. Lube-oil-level indicator			
18. Lube-oil-fill level			
19. All lube-oil line connections			
20. All lube-oil lines			
21. Fuel type and amount			
22. All fuel-line connections			
23. All fuel lines			

24. Fuel filter
25. Coupling and shaft alignment
26. Voltage regulators
27. Battery-charger connections
28. All wiring connections
29. Instrumentation
30. Hazards to personnel
31. Base
32. Nameplates
33. Paint
34. Exhaust-heat recovery unit
35. Switchboard
36. Switchgear

2.27.2 Factory Tests

On engine-generator set tests where the engine and generator are required to be connected and operated together, the load power factor shall be the power factor specified in the engine generator set parameter schedule. Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions of terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Tests specifically for the generator may be performed utilizing any prime mover.

a. Insulation Resistance for Stator and Exciter Test, IEEE Std 115 and IEEE Std 43, to the performance criteria in NEMA MG 1, Part 22. Generator manufacturer's production line test is acceptable.

b. High Potential Test, per IEEE Std 115 and NEMA MG 1, test voltage in accordance with NEMA MG 1. Generator manufacturer's production line test is acceptable.

c. Winding Resistance Test, Stator and Exciter, per IEEE Std 115. Generator manufacturer's production line test is acceptable.

d. Overspeed Vibration Test, per IEEE Std 115 to the performance criteria in NEMA MG 1. The test shall be performed at 110% of rated speed for 5 minutes. The vibration shall be measured at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Vibration amplitude and speed shall be recorded at one minute intervals.

e. Phase Balance Voltage Test, to the performance criteria specified in paragraph GENERATOR. This test can be performed with any prime mover. Generator manufacturer's production line test results are acceptable.

(1) Start and operate the generator at no load.

(2) Adjust a regulated phase voltage (line-to-neutral) to rated voltage.

(3) Read and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(4) Apply 75% rated load and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(5) Apply rated load and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(6) Calculate average line-neutral voltage and percent deviation of individual line-neutral voltages from average for each load condition.

f. Current Balance on Stator Winding Test, by measuring the current on each phase of the winding with the generator operating at 100 % of Rated Output Capacity, with the load impedance equal for each of the three phases: to the performance criteria specified in paragraph GENERATOR.

g. Voltage Waveform Deviation and Distortion Test per IEEE Std 115 to the performance criteria specified in paragraph GENERATOR. High-speed recording instruments capable of recording voltage waveform deviation and all distortion, including harmonic distortion shall be used. Representation of results shall include appropriate scales to provide a means to measure and interpret results.

h. Voltage and Frequency Droop Test. Verify that the output voltage and frequency are within the specified parameters as follows:

(1.) With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency. Record the generator output frequency and line-line and line-neutral voltages.

(2.) Increase load to Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.

3. Calculate the percent droop for voltage and frequency with the following equations:

$$\text{Voltage droop \%} = \frac{\text{(No-Load Volts) - (Rated Capacity volts)}}{\text{(Service-Load Volts)}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{(No-Load Hertz) - (Rated Capacity hertz)}}{\text{(Service-Load hertz)}} \times 100$$

4. Repeat steps 1 through 3 two additional times without making any adjustments.

i. Frequency and Voltage Stability and Transient Response. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Tabular data shall include the following:

Ambient temperature (at 15 minute intervals).

Generator output current (before and after load changes).

Generator output voltage (before and after load changes).

Frequency (before and after load changes).

Generator output power (before and after load changes).

Graphic representations shall include the actual instrument trace of voltage and frequency showing: charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

(1.) Perform and record engine manufacturer's recommended prestarting checks and inspections.

(2.) Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

(3.) With the unit at no load, apply the Maximum Step Load Increase.

(4.) Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

(5.) Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100% of Service Load.

(6.) Apply the Maximum Step Load Increase.

(7.) Decrease load to zero percent in steps equal to the Maximum

Step Load Decrease.

(8.) Repeat steps 3. through 7.

j. Test Voltage Unbalance with Unbalanced Load (Line-to-Neutral) to the performance criteria specified in paragraph GENERATOR. Prototype test data is acceptable in lieu of the actual test. This test may be performed using any prime mover.

(1.) Start and operate the generator set at rate voltage, no load, rated frequency, and under control of the voltage regulator. Read and record the generator frequency, line-to-neutral voltages, and the line-to-line voltages.

(2.) Apply the specified load between terminals L_1-L_2, L_2-L_0, and L_3-L_0 in turn. Record all instrument readings at each line-neutral condition.

(3.) Express the greatest difference between any two of the line-to-line voltages and any two of the line-to-neutral voltages as a percent of rated voltage.

(4.) Compare the largest differences expressed in percent with the maximum allowable difference specified.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturers standard connection is threaded. Except where otherwise specified, welded flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to equipment shall be made with vibration-isolation-type flexible connectors. Piping and tubing shall be supported and aligned to prevent stressing of flexible hoses and connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors and openings, to permit thermal expansion and contraction without damage to joints or hangers, and shall be installed with a 15 mm (1/2 inch) drain valve with cap at each low point.

3.2.1 Support

Hangers, inserts, and supports shall be of sufficient size to accommodate

any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 2.1 m on center for pipes 50 mm (2 inches) in diameter or less, not more than 3.6 m on center for pipes larger than 50 mm (2 inches) but smaller than 100 mm (4 inches) in diameter, and not more than 5.2 m on center for pipes larger than 100 mm in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.1.1 Ceiling and Roof

Exhaust piping shall be supported with appropriately sized Type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized Type 1 clevis and threaded rods.

3.2.1.2 Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized Type 33 brackets with the appropriate ceiling and roof pipe supports.

3.2.2 Flanged Joints

Flanges shall be Class 125 type, drilled, and of the proper size and configuration to match the equipment and diesel engine connections. Flanged joints shall be gasketed and made up square and tight.

3.2.3 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of debris.

3.2.4 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be minimum 15 mm (1/2 inch), and where pipes pass through combustible materials 25 mm (1 inch) larger than the outside diameter of the passing pipe or pipe insulation/covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for conduit, cable trays, and raceways attached to engine-generator sets. Metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor. Terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of all parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments, replacements, or repairs shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be recorded in 15 minute intervals during engine-generator set operation and shall include: readings of all engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set.Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions of terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulations shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

For all engine-generator set operating tests the load power factor shall be the power factor specified in the engine-generator set parameter schedule.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments provided as permanent equipment shall be verified during test runs, using test instruments of greater precision and accuracy. Test instrument accuracy shall be within the following: current plus or minus 1.5%, voltage plus or minus 1.5%, real power plus or minus 1.5%, reactive power plus or minus 1.5%, power factor plus or minus 3%, frequency plus or minus 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however, the following general order of testing shall be followed: Construction Tests; Inspections; Pre-operational Tests; Safety Run Tests; Performance

Tests; and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping which is external to the engine-generator set shall be pressure tested with air pressure at 150% of the maximum anticipated working pressure, but not less than 1.03 MPa, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the main disconnect switch. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repair cable shall be retested until failures have been eliminated.

b. Ground-Resistance Tests. The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance

of separate systems may be used to meet the requirements resistance, but the specified number of electrodes must still be provided as follows:

(1.) Single rod electrode - 25 ohms.

c. Circuit breakers and switchgear shall be examined and tested in accordance with the manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1.	Drive belts.	(I)
2.	Governor type and features.	(I)
3.	Engine timing mark.	(I)
4.	Starting motor.	(I)
5.	Starting aids.	(I)
6.	Coolant type and concentration.	(D)
7.	Radiator drains.	(I)
8.	Block coolant drains.	(I)
9.	Coolant fill level.	(I)
10.	Coolant line connections.	(I)
11.	Coolant hoses.	(I)
12.	Combustion air filter.	(I)
13.	Intake air silencer.	(I)
14.	Lube oil type.	(D)
15.	Lube oil sump drain.	(I)
16.	Lube-oil filter.	(I)
17.	Lube-oil level indicator.	(I)
18.	Lube-oil fill level.	(I)
19.	Lube-oil line connections.	(I)
20.	Lube-oil lines.	(I)
21.	Fuel type.	(D)
22.	Fuel-level.	(I)
23.	Fuel-line connections.	(I)
24.	Fuel lines.	(I)
25.	Fuel filter.	(I)
26.	Access for maintenance.	(I)
27.	Voltage regulator.	(I)
28.	Battery-charger connections.	(I)
29.	Wiring & terminations.	(I)

30. Instrumentation. (I)
31. Hazards to personnel. (I)
32. Base. (I)
33. Nameplates. (I)
34. Paint. (I)
35. Exhaust-heat system. (I)
36. Exhaust muffler. (I)
37. Switchboard. (I)
38. Switchgear. (I)
39. Access provided to controls. (I)
40. Enclosure is weather resistant. (I)
41. Engine & generator mounting bolts (application). (I)

3.5.4 Pre-operational Tests

3.5.4.1 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the installation coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.1.

3.5.4.2 Insulation Test

Generator and exciter circuits insulation resistance shall be tested in accordance with IEEE Std 43. Results of insulation resistance tests shall be recorded. Readings shall be within limits specified by the manufacturer. Precautions shall be taken to preclude damaging generator components during test.

3.5.4.3 Engine-Generator Connection Coupling Test

When the generator provided is a two-bearing machine, the engine-generator connection coupling shall be inspected and checked by dial indicator to prove that no misalignment has occurred. The dial indicator shall measure variation in radial positioning and axial clearance between the coupling halves. Readings shall be taken at four points, spaced 90 degrees apart. Solid couplings and pin-type flexible couplings shall be aligned within a total indicator reading of 0.012 to 0.025 mm for both parallel and angular misalignment. For gear-type or grid-type couplings, 0.05 mm will be acceptable.

3.5.5 Safety Run Test

For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated safety tests shall be repeated.

a. Perform and record engine manufacturer's recommended prestarting

checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine-generator set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If either temperature reading exceeds the value required for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 2 hours at 75% of Service Load.

l. Verify proper operation and setpoints of gauges and instruments.

m. Verify proper operation of ancillary equipment.

n. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

o. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75% of Service Load.

p. Manually adjust the governor to increase engine speed to within 2% of the overspeed trip speed previously determined and operate at that point for 5 minutes. Manually adjust the governor to the rated frequency.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine.

s. Attach a manifold to the engine oil system (at the oil pressure sensor port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75% of Service Load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of Service Load. Record the maximum sound level in each frequency band at a distance of 22.9 m from the end of the exhaust and air intake piping directly along the path of intake and discharge for horizontal piping; or at a radius of 10.7 m from the engine at 45 degrees apart in all directions for vertical piping. If a sound

limiting enclosure is not provided, the muffler and air intake silencer shall be modified or replaced as required to meet the sound limitations of this specification. If the sound limitations can not be obtained by modifying or replacing the muffler and air intake silencer, the contractor shall notify the Contracting Officers Representative and provide a recommendation for meeting the sound limitations.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

3.5.6 Performance Tests

In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated tests shall be repeated.

3.5.6.1 Continuous Engine Load Run Test

Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Data taken at 15 minute intervals shall include the following:

Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

Pressure: Lube-oil.

Temperature: Coolant.
Lube-oil.
Exhaust.
Ambient.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.

c. Operate the engine generator-set for 2 hours at 75% of Service

Load.

d. Increase load to 100% of Service Load and operate the engine generator-set for 4 hours.

e. For prime rated units, increase load to 110% of Service Load and operate the engine generator-set for 2 hours.

f. Decrease load to 100% of Service Load and operate the engine generator-set for 2 hours or until all temperatures have stabilized.

g. Remove load from the engine-generator set.

3.5.6.2 Voltage and Frequency Droop Test

For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. Record the generator output frequency and line-line and line-neutral voltages following each load change.

a. With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency.

b. Increase load to 100% of Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.

c. Calculate the percent droop for voltage and frequency with the following equations.

$$\text{Voltage droop \%} = \frac{\text{No-load volts - rated output capacity volts}}{\text{Rated output capacity volts}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{No load hertz - rated output capacity hertz}}{\text{Rated output capacity volts}} \times 100$$

d. Repeat steps a. through c. two additional times without making any adjustments.

3.5.6.3 Voltage Regulator Range Test

a. While operating at no load, verify that the voltage regulator adjusts from 90% to 110% of rated voltage.

b. Increase load to 100% of Rated Output Capacity. Verify that the voltage regulator adjusts from 90% to 110% of rated voltage.

3.5.6.4 Governor Adjustment Range Test

a. While operating at no load, verify that the governor adjusts from

90% to 110% of rated frequency.

b. Increase load to 100% of Rated Output Capacity. Verify that the governor adjusts from 90% to 110% of rated frequency.

3.5.6.5 Frequency and Voltage Stability and Transient Response

Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Tabular data shall include the following:

(1.) Ambient temperature (at 15 minute intervals).

(2.) Generator output current (before and after load changes).

(3.) Generator output voltage (before and after load changes).

(4.) Frequency (before and after load changes).

(5.) Generator output power (before and after load changes.

(6.) Graphic representations shall include the actual instrument trace of voltage and frequency showing:

Charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

c. With the unit at no load, apply the Maximum Step Load Increase.

d. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.

e. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100% of Service Load.

f. Apply the Maximum Step Load Increase.

g. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

h. Repeat steps c. through g.

3.5.7 NOT USED

3.5.7.1 Combinations

Connect each set, while operating at no load, parallel with one other set in the system, operating at service load, until all possible two-unit-in-parallel combinations have been achieved. Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive loads. Document stabilization of voltage and frequency within specified bandwidth, the active power division, active power exchange, reactive power division, and voltage and frequency stability and transient response in the following steps for each combination.

a. Divide the load proportionally between the sets and operate in parallel for 15 minutes.

b. Increase the load, in steps equal to the Maximum Step Increase, until each set is loaded to its service load.

c. Decrease the load, in steps equal to the Maximum Step Decrease, until each set is loaded to approximately 25% of its service load.

d. Increase the load, in steps equal to the Maximum Step Increase, until each set is loaded to approximately 50% of its service load Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive load.

e. Reduce the sum of the loads on both sets to the output rating of the smaller set.

f. Transfer a load equal to the output rating of the smaller of the 2 sets to and from each set. Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive load.

g. Document the active power division, active power exchange, reactive power division, and voltage and frequency stability and transient response .

3.5.7.2 Multiple Combinations

Connect each set, while operating at no load, parallel with all multiple combinations of all other set in the system, while operating at service load, until all multiple combinations of parallel operations have been achieved.

3.5.8 NOT USED

3.5.9 NOT USED

3.5.10 NOT USED

3.5.11 Fuel Consumption Tests

Fuel consumption tests to confirm the manufacturer's certified rates shall be performed on engine generator set and the results tabulated and averaged. Fuel consumption tests shall be conducted under the direct supervision of the engine manufacturer's representative. Fuel consumption readings shall be taken at 15 minute intervals, over a minimum period of 1 hour at 50% Service Load, 1 hour at 75% Service Load, and 4 hours at 100% Service Load. Fuel consumption data may be taken during the 75% load test and 100% load tests. Fuel consumption readings at site conditions shall be correlated to the guarantee-baseline conditions. Test report shall contain: readings of the output frequency, voltage, current, power factor, and power; barometric pressure; ambient temperature; intake-air temperature; fuel temperature; the site fuel consumption readings, adjustment calculations, factors, and source references for correlation of actual consumption rate of the guaranteed rate.

a. Start and operate the generator set and allow it to stabilize at rated load, rated voltage and rated frequency. During this period, readings of all instruments including thermal instrumentation shall be recorded at minimum intervals of 10 minutes. If necessary, adjustments to the load, voltage and frequency may be made to maintain rated load at rated voltage and rated frequency. However, adjustments to the voltage and frequency shall be limited to those adjustments available to the operator, specifically adjustments to the voltage or frequency adjust devices. On generator sets utilizing a droop-type speed control system as the prime speed control, the speed and droop portions of the control may be adjusted. No other adjustments to the voltage and frequency control systems shall be made unless permitted by the procurement document. Adjustments to the load, voltage or frequency controls shall be recorded on the data sheet. Unless otherwise specified in the procurement document, stabilization will be consideration to have occurred when four consecutive voltage and current recorded readings of the generator (or exciter) field either remain unchanged or have only minor variations about an equilibrium condition with no evident continued increase or decrease in value after the last adjustment to the load, voltage or frequency has been made.

b. Perform one of the following procedures:

BALANCE SCALE PROCEDURE.

(1.) Supply fuel from auxiliary container mounted on a balance scale.

(2.) After stabilization has occurred, set the balance weights at any convenient value slightly less than the total weight of the fuel and container.

(3.) Start the stopwatch when the balance weights fall and record the total weight.

(4.) Reduce the balance weight a convenient amount and record the amount of the weights removed.

(5.) Stop the stopwatch when the balance weights fall and record the total weight and the elapsed time.

(6.) Repeat steps (1) thru (2) above until the timed portion of the test exceeds the 2 hours.

(7.) From the total elapsed time and total of the weights removed calculate the fuel consumption in terms of pounds per hour.

(8.) Using the value obtained in step (7) above, compute the rate of fuel consumption per kilowatt hour, as follows:

$$\text{Pounds per kWH} = \frac{\text{Fuel Consumption in Pounds per Hour}}{\text{kW Load}}$$

(9.) Repeat the test for each load condition specified.

(10.) Determine the capacity of the generator set fuel tank in pounds of fuel.

(11.) For each specified load, compute the number of continuous hours the generator set will operate on a full tank of fuel. The following formula shall be used.

$$\text{Operating hours} = \frac{\text{Fuel Tank Capacity (Pounds)}}{\text{Fuel Consumption (Pounds per hour)}}$$

ALTERNATE PROCEDURE FOR WEIGHING FUEL

(1.) Supply fuel from the auxiliary fuel container, mounted on a platform balance, or other weighing device.

(2.) After stabilization has occurred, record weight readings every one-half hour for a period of 2 hours.

(3.) Calculate the average hourly fuel consumption rate in pounds per hour.

(4.) Using the average hourly fuel consumption rate obtained above, compute the rate of fuel consumption per kilowatt hour, as follows:

$$\text{Pounds per kWH} = \frac{\text{Fuel Consumption}}{\text{kW Load}}$$

(5.) Repeat test for each load condition specified.

(6.) Determine the capacity of the generator set fuel tank in pounds of fuel.

(7.) for each specified load test, compute the number of continuous ours the generator set will operate on a full tank of fuel. The following formula shall be used:

$$\text{Operating Hours} = \frac{\text{Fuel Tank Capacity (Pounds)}}{\text{Fuel Consumption (Pounds per Hour)}}$$

ALTERNATE PROCEDURE USING FLOWMETER.

Flowmeters may be used to determine the fuel rate. They usually are calibrated in either gallons per hour, or pounds per hour, for a fuel of a definite specific gravity and temperature.

(1.) After stabilization has occurred record the fuel consumption rate, and continue to record the fuel consumption rate at one-half hour intervals for 2 hours.

(2.) Determine the average of the readings (correct for fuel specific gravity and temperature). This is the fuel consumption rate and should be converted, if necessary, to pounds per hour.

(3.) Using the average value obtained above, calculate the rate of fuel consumption per kilowatt hour.

(4.) Repeat the test for each load condition specified.

(5.) Determine the capacity of the generator set fuel tank in pounds of fuel.

(6.) For each specified load test, compute the number of continuous hours the generator set will operate on a full tank of fuel. The following formula shall be used:

$$\text{Operating Hours} = \frac{\text{Fuel Tank Capacity (Pounds)}}{\text{Fuel Consumption (Pounds per Hour)}}$$

c. Results. Compare the operating hours or the fuel consumption rate per kWH.

3.5.12 Final Testing and Inspection

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the Maximum Step Load Increase to 100% of Service Load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end

bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 8 hours at Service Load, then re-examining the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.6 POSTED DATA AND INSTRUCTIONS

Posted Data and Instructions shall be posted prior to field acceptance testing of the engine generator set. Two sets of instructions/data shall be typed in 8 1/2" x 11" format, laminated in weatherproof plastic, and placed in three-ring vinyl binders. The binders shall be placed as directed by the Contracting Officer. The instructions shall be in place prior to acceptance of the engine generator set installation. First set shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.7 ONSITE TRAINING

The Contractor shall conduct training course for operating staff and maintenance contract personnel as designated by the Contracting Officer. The training period shall consist of a total 16 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. All operation and maintenance manuals shall bee approved and made available for the training course. All posted instructions shall be approved and posted prior to the beginning date of the training course. The training course schedule shall be coordinated with the Using Service's work schedule, and submitted for approval 14 days prior to beginning date of proposed beginning date of training. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as major elements of the

operation and maintenance manuals. Additionally, the course instructions shall demonstrate routine maintenance procedures as described in the operation and maintenance manuals. Two copies of a video tape of the manufacturers operating and maintenance training course shall be submitted.

3.8 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the contractor has successfully completed all tests and all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 16370A

ELECTRICAL DISTRIBUTION SYSTEM, AERIAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C29.2	(1992) Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.4	(1989; R 1995) Wet-Process Porcelain Insulators - Strain Type
ANSI C29.5	(1984; R 1995) Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types
ANSI C29.6	(1996) Wet-Process Porcelain Insulators - High-Voltage Pin Type
ANSI C29.8	(1985; R 1995) Wet-Process Porcelain Insulators - Apparatus, Cap and Pin Type
ANSI C29.9	(1983; R 1996) Wet-Process Porcelain Insulators - Apparatus, Post-Type
ANSI C135.1	(1979) Galvanized Steel Bolts and Nuts for Overhead Line Construction
ANSI C135.2	(1999) Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction
ANSI C135.4	(1987) Zinc-Coated Ferrous Eyebolts and Nuts for Overhead Line Construction
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction
ANSI C135.22	(1988) Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM A 123/A 123M	(2001a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 575	(1996; R 2002) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 2000) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 1	(2001) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 228	(1998) Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM B 398/B 398M	(1999) Aluminum-Alloy 6201-T81 Wire for Electrical Purposes
ASTM B 399/B 399M	(1999) Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C4	(1999) Poles - Preservative Treatment by Pressure Processes
AWPA C25	(2001) Sawn Crossarms - Preservative Treatment by Pressure Processes
AWPA P1/P13	(2001) Standard for Creosote Preservative
AWPA P5	(2001) Standard for Waterborne Preservatives
AWPA P8	(2001) Standard for Oil-Borne Preservatives
AWPA P9	(2001) Standards for Solvents and Formulations for Organic Preservative

Systems

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C57.19.00	(1991; R 1997) Standard General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
IEEE C57.19.01	(2000) Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1999) Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(2000) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 242	(2001) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE Std 399	(1997) Recommended Practice for Power Systems Analysis - Brown Book
IEEE Std 404	(2000) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA HV 2	(1984; R 1996) Application Guide for Ceramic Suspension Insulators
NEMA LA 1	(1992; R 1999) Surge Arresters
NEMA SG 2	(1993) High Voltage Fuses

NEMA WC 74	(2000) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS REA Bull 1728H-701	(1993) REA Specification for Wood Crossarms (Solid and Laminated), Transmission Timbers and Pole Keys

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; Rev thru Feb 2001) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru May 2001) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev thru May 2001) Wire Connectors for Use with Aluminum Conductors

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System; G, RE

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings. Detail drawings shall as a minimum include:

a. Poles.

b. Crossarms.

c. Conductors.

d. Insulators.

e. Surge arresters.

f. Fused cutout.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

As-Built Drawings; G, RE

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon

review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Fault Current Analysis; G, RE

The analysis shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. The Government shall not be held responsible for any changes to equipment, device settings, ratings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the analysis.

Nameplates; G, RE

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment; G, RE

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include the item number, the quantity of items proposed, and the name of the manufacturer of the item.

General Installation Requirements; G, RE

As a minimum, installation procedures for regulators, transformers and reclosers. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests; G, RE

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests specified in applicable publications or in these specifications.

Field Testing; G, RE

A proposed field test plan 20 days prior to testing the installed system. No field test shall be performed until the test

plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests; G, RE

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of 5 rings, and including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

SD-07 Certificates

Material and Equipment; G, RE

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided under this section of the specifications conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform thereto. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms thereto. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms thereto. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies.

SD-10 Operation and Maintenance Data

Electrical Distribution System; G, RE

Six copies of Operation and Maintenance manuals electrical distribution system shall be provided, within 7 calendar days following the completion of tests and shall include assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare-parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

Three additional copies of the instructions manual within 30 calendar days following the approval of the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the Contracting Officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Products shall conform to the following requirements. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.3 NAMEPLATES

2.3.1 General

Each major component shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. As a minimum, nameplates shall be provided for meters and switches.

2.4 CORROSION PROTECTION

2.4.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

2.4.2 Ferrous Metal Materials

2.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.4.2.2 Equipment

Equipment and component items, including but not limited to transformers and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The described test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900

PAINTS AND COATINGS.

2.5 CONDUCTORS, CONNECTORS, AND SPLICES

2.5.1 Aluminum-Composition Conductors

All-aluminum-alloy-conductors, AAAC, shall be alloy 6201-T81 and comply with ASTM B 398/B 398M and ASTM B 399/B 399M.

2.5.2 Copper Conductors

Hard-drawn-copper conductors shall comply with ASTM B 1 and ASTM B 8 as appropriate for the conductor size.

2.5.3 Connectors and Splices

Connectors and splices shall be of copper alloys for copper conductors, aluminum alloys for aluminum-composition conductors, and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. Aluminum-composition and aluminum-composition to copper shall comply with UL 486B, and copper-to-copper shall comply with UL 486A.

2.6 MEDIUM-VOLTAGE LINES

2.6.1 Bare Medium-Voltage Lines

Bare medium-voltage line conductors shall be all-aluminum-alloy-conductor, AAAC. Conductor types shall not be mixed on any project, unless specifically indicated. Conductors larger than No. 2 AWG shall be stranded.

2.6.2 Insulated Medium-Voltage Lines

Insulated medium-voltage line conductors shall be of the factory-assembled, messenger-supported type, having a rated circuit voltage of 15 kV, and a 133 percent insulation level. Conductor material shall be copper. Insulation shall be ethylene-propylene-rubber (EPR) conforming to NEMA WC 8 & AEIC C56.

2.7 NOT USED

2.8 POLES AND HARDWARE

Poles shall be of lengths and classes indicated.

2.8.1 Wood Poles

Wood poles shall comply with ANSI O5.1, and shall be pressure treated in accordance with AWPA C4, with creosote conforming to AWPA P1/P13or with oil-borne preservatives and petroleum conforming to AWPA P8 and AWPA P9, respectively, and waterborne preservatives conforming to AWPA P5. Waterborne preservatives shall be either chromated or ammoniacal copper arsenate. Any species listed in ANSI O5.1 for which a preservative treatment is not specified in AWPA C4, shall not be used; northern white cedar, if treated as specified for western red cedar, and western fir, if

treated as specified for Douglas fir, may be used. Wood poles shall have pole markings located approximately 3 m from pole butts for poles 15.2 m (50 feet) or less in length, and 4 m from the pole butts for poles longer than 16.8 m (55 feet) in length. Poles shall be machine trimmed by turning smooth full length, and shall be roofed, gained, and bored prior to pressure treatment. Where poles are not provided with factory-cut gains, metal gain plates shall be provided.

2.8.2 NOT USED

2.8.3 NOT USED

2.8.4 Pole Line Hardware

Zinc-coated hardware shall comply with ANSI C135.1, ANSI C135.2, ANSI C135.4, ANSI C135.14 ANSI C135.22. Steel hardware shall comply with ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized malleable or ductile iron in accordance with ASTM A 153/A 153M. Washers shall be installed under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts shall be approximately 57.2 mm square and 4.8 mm (3/16 inch) thick. The diameter of holes in washers shall be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts shall be of the proper size to fit over square shanks of bolts. Eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

2.8.5 Armless Construction

Pole mounting brackets for line-post or pin insulators and eye bolts for suspension insulators shall be as shown. Brackets shall be attached to poles with a minimum of two bolts. Brackets may be either provided integrally as part of an insulator or attached to an insulator with a suitable stud. Bracket mounting surface shall be suitable for the shape of the pole. Brackets for wood poles shall have wood gripping members. Horizontal offset brackets shall have a 5-degree uplift angle. Pole top brackets shall conform to ANSI C135.22, except for modifications necessary to provide support for a line-post insulator. Brackets shall provide a strength exceeding that of the required insulator strength, but in no case less than a 12.5 kN (2800 pound) cantilever strength.

2.8.6 Guy Assemblies

Guy assemblies shall be copper-clad steel in accordance with ASTM B 228. Guy assemblies, including insulators and attachments, shall provide a strength exceeding the required guy strength. Three-eye thimbles shall be provided on anchor rods to permit attachment of individual primary, secondary, and communication down guys. Anchors shall provide adequate strength to support all loads. Guy strand shall be 7 strand. Guy material shall be Class 30 EHS copper-clad steel, with a minimum breaking strength not less than 26.7 kN (6000 pounds), except where two or more guys are used to provide the required strength. Guy rods shall be not less than 2.4 m (8 feet) in length by 19.1 mm (3/4 inch) in diameter.

2.9 INSULATORS

Insulators shall comply with NEMA HV 2 for general requirements. Suspension insulators shall be used at corners, angles, dead-ends, other areas where line insulators do not provide adequate strength, and as indicated. Mechanical strength of suspension insulators and hardware shall exceed the rated breaking strength of the attached conductors.

2.9.1 Medium-Voltage Line Insulators

Medium-voltage line insulators shall comply with ANSI C29.2, ANSI C29.5, and ANSI C29.6, and as applicable. Ratings shall not be lower than the ANSI classes indicated in TABLE I. Horizontal line-post insulators shall be used for armless construction and shall have the same mechanical and electrical ratings as vertical line-post insulators for the ANSI class indicated, but shall be modified to be suitable for horizontal installation. Where line-post insulators are used for angles greater than 15 degrees, clamp-top fittings shall be provided as well as for other locations shown. Conductor clamps for use with clamp-top, line-post insulators shall be hot-dip galvanized malleable iron for copper conductors and aluminum alloy for aluminum-composition conductors. Either line-post or pin insulators may be used for crossarm construction. Pin insulators for use on voltages in excess of 6 kV phase-to-phase shall be radio-interference-freed or else line-post insulators shall be used.

TABLE I

MINIMUM ANSI RATING OF MEDIUM-VOLTAGE INSULATORS BY CLASS

Voltage Level	Line-Post	Pin	Suspension
6 kV to 15 kV	57-1 or 11	55-5	Two 52-2
	57-2 or 12	56-3	Two 52-3 or 4

2.9.2 NOT USED

2.9.3 Strain Insulators for Guy Wires

Strain insulators for use in insulated guy assemblies shall comply with ANSI C29.4 for porcelain or equivalent fiberglass, and shall have a mechanical strength exceeding the rated breaking strength of the attached guy wire. Insulators shall be not smaller than Class 54-3 for lines of 6 kV to 15 kV.

2.9.4 Apparatus Insulators

Apparatus insulators shall comply with IEEE C57.19.00, IEEE C57.19.01, ANSI C29.8, and ANSI C29.9 as applicable.

2.10 CROSSARM ASSEMBLIES

2.10.1 Crossarms

Crossarms shall comply with RUS REA Bull 1728H-701 and shall be solid wood, distribution type, except cross-sectional area with pressure treatment conforming to AWPA C25, and a 6.4 mm (1/4 inch), 45 degree chamfer on all top edges. Cross-sectional area minimum dimensions shall be 108.0 mm (4-1/4 inches) in height by 82.6 mm (3-1/4 inches) in depth in accordance with IEEE C2 for Grade B construction. Crossarms shall be 2.4 m (8 feet) in length, except that 3.1 m (10 foot) crossarms shall be used for crossarm-mounted banked single-phase transformers or elsewhere as indicated. Crossarms shall be machined, chamfered, trimmed, and bored for stud and bolt holes before pressure treatment. Factory drilling shall be provided for pole and brace mounting, for four pin or four vertical line-post insulators, and for four suspension insulators, except where otherwise indicated or required. Drilling shall provide required climbing space and wire clearances. Crossarms shall be straight and free of twists to within 2.5 mm per 304.8 mm (1/10 inch per foot) of length. Bend or twist shall be in one direction only.

2.11 NOT USED

2.12 NOT USED

2.13 FUSES AND SWITCHES, MEDIUM-VOLTAGE

2.13.1 Fuse Cutouts

Medium-voltage fuses and cutouts shall comply with NEMA SG 2 and shall be of the loadbreak open type construction rated 15 kV and of the heavy-duty type. Open-link cut-outs are not acceptable. Fuses shall be either indicating or dropout type. Fuse ratings shall be as indicated. Fuse cutouts shall be equipped with mounting brackets suitable for the indicated installations.

2.14 NOT USED

2.15 NOT USED

2.16 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1 and IEEE C62.1, IEEE C62.2, and IEEE C62.11, and shall be provided for protection of aerial-to-underground transitions, automatic circuit reclosers, capacitor equipment, group-operated load-interrupter switches, transformers and other indicated equipment. Arresters shall be intermediate class, rated as shown. Arresters for use at elevations in excess of 1.8 km (6000 feet) above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type suitable for outdoor installations.

2.17 NOT USED

2.18 GROUNDING AND BONDING

2.18.1 Driven Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 19.1 mm (3/4 inch) in diameter by 3.1 meter (10 feet) in length of the sectional type driven full length into the earth.

2.18.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as the phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.19 NOT USED

2.20 WARNING SIGNS

Warning signs shall be porcelain enameled steel or approved equal. Voltage warning signs shall comply with IEEE C2.

2.21 NOT USED

2.22 NOT USED

2.23 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a fault current analysis. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide list of references complete with points of contact, address and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.23.1 Scope of Analyses

The fault current analysis shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.23.2 Determination of Facts

The Contractor shall coordinate with the commercial power company Ft. Story DPW for fault current availability at the site.

2.23.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformer points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformer point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches,

breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.23.4 Fault Current Analysis

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242 and IEEE Std 399. Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.23.5 Fault Current Availability

Balanced three-phased fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed in conduits or underground and splices and terminations for medium-voltage cable shall conform to the requirements of Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Secondary circuits installed in conduit on poles shall conform to the requirements of Section 16415A ELECTRICAL WORK, INTERIOR.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of IEEE C2 for medium loading districts, Grade B construction. No reduction in clearance shall be made. The installation shall also comply with the applicable parts of NFPA 70.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall notify the Contracting Officer of any discrepancy before performing any work.

3.2 POLE INSTALLATION

3.2.1 Wood Pole Setting

Wood Pole Setting: Wood poles shall be set straight and firm. In normal firm ground, minimum pole-setting depths shall be as listed in Table II. In rocky or swampy ground, pole-setting depths shall be decreased or increased respectively in accordance with the local utility's published standards and as approved. In swampy or soft ground, a bog shoe shall be used where support for a pole is required. Poles in straight runs shall be in a straight line. Curved poles shall be placed with curvatures in the

direction of the pole line. Poles shall be set to maintain as even a grade as practicable. When the average ground run is level, consecutive poles shall not vary more than 1.5 m in height. When the ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top end and roofed. If any pole is shortened after treatment, the shortened end of the pole shall be given an application of hot preservative. Where poles are set on hilly terrain, along edges of cuts or embankments, or where soil may be washed out, special precautions shall be taken to ensure durable pole foundations, and the setting depth shall be measured from the lower side of the pole. Holes shall be dug large enough to permit proper use of tampers to the full depth of a hole. Earth shall be placed into the hole in 300 mm maximum layers, then thoroughly tamped before the next layer is placed. Surplus earth shall be placed around each pole in a conical shape and packed tightly to drain water away from poles.

TABLE II

MINIMUM POLE-SETTING DEPTH (METERS)

Length Overall Meters	Straight Lines	Curves, Corners, and Points of Extra Strain
6.1	1.5	1.5
7.6	1.7	1.7
9.2	1.7	1.7
10.7	1.8	1.8
12.2	1.8	1.8
13.7	2.0	2.1
15.2	2.1	2.3
16.7	2.3	2.5
18.3	2.5	2.6
19.8	2.6	2.6
21.3	2.8	2.9
22.9	2.9	3.0
24.4	3.0	3.2
25.9	3.2	3.3
27.4	3.3	3.5
28.9	3.5	3.7
30.5	3.7	3.8

3.2.2 Aluminum, Steel, and Concrete Pole Setting

Poles shall be mounted on cast-in-place or power-installed screw foundations. Concrete poles shall be embedded in accordance with the details shown. Conduit elbows shall be provided for cable entrances into pole interiors.

3.2.2.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts

accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufacturer's standard, and not less than necessary to meet the pole wind loading specified herein and other design requirements.

3.2.2.2 Power-Installed Screw Foundations

Power-installed screw foundations may be used if they have the required strength, mounting-bolt, and top plate dimensions. Screw foundations shall be of at least 6.4 mm (1/4 inch) thick structural steel conforming to ASTM A 36/A 36M and hot-dip galvanized in accordance with ASTM A 123/A 123M. Conduit slots in screw foundation shafts and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength shall be approved before installation of screw foundation is permitted. Calculations shall be submitted in accordance with the detail drawings portion of paragraph SUBMITTALS.

3.3 CROSSARM MOUNTING

Crossarms shall be bolted to poles with 15.9 mm (5/8 inch) through-bolts with square washers at each end. Bolts shall extend not less than 3 mm nor more than 50 mm beyond nuts. On single crossarm construction, the bolt head shall be installed on the crossarm side of the pole. Wood crossarm braces shall be provided on crossarms. Flat braces may be provided for 2.4 m (8 foot) crossarms and shall be 6.4 by 31.8 mm (1/4 by 1-1/4 inches), not less than 700 mm (28 inches) in length. Flat braces shall be bolted to arms with 9.5 mm (3/8 inch) carriage bolts with round or square washers between boltheads and crossarms, and secured to poles with 50.8 by 101.6 mm (1/2 by 4 inch) lag screws after crossarms are leveled and aligned. Angle braces are required for 3.1 m (10 foot) crossarms and shall be 1.5 m (60 inch) span by 457.2 mm (18 inch) drop formed in one piece from 38.1 by 38.1 by 4.8 mm (1-1/2 by 1-1/2 by 3/16 inch) angle. Angle braces shall be bolted to crossarms with 50.8 mm (1/2 inch) bolts with round or square washers between boltheads and crossarms, and secured to poles with 15.9 mm (5/8 inch) through-bolts. Double crossarms shall be securely held in position by means of 15.9 mm (5/8 inch) double-arming bolts. Each double-arming bolt shall be equipped with four nuts and four square washers.

3.3.1 Line Arms and Buck Arms

Line arms and buck arms shall be set at right angles to lines for straight runs and for angles 45 degrees and greater; and line arms shall bisect angles of turns of less than 45 degrees. Dead-end assemblies shall be used for turns where shown. Buckarms shall be installed, as shown, at corners and junction poles. Double crossarms shall be provided at ends of joint use or conflict sections, at dead-ends, and at angles and corners to provide adequate vertical and longitudinal strength. Double crossarms shall be provided at each line-crossing structure and where lines not attached to the same pole cross each other.

3.3.2 Equipment Arms

Equipment arms shall be set parallel or at right angles to lines as required to provide climbing space. Equipment arms shall be located below line construction to provide necessary wire and equipment clearances.

3.4 GUY INSTALLATION

Guys shall be provided where shown, with loads and strengths as indicated, and wherever conductor tensions are not balanced, such as at angles, corners, and dead-ends. Where a single guy will not provide the required strength, two or more guys shall be provided. Where guys are wrapped around poles, at least two guy hooks shall be provided and pole shims shall be provided where guy tension exceeds 27 kN (6000 pounds). Guy clamps 152.4 mm (6 inches) in length with three 15.9 mm (5/8 inch) bolts, or offset-type guy clamps, or approved guy grips shall be provided at each guy terminal. Guy-strain insulators shall be provided in each guy for wood poles. Multiple-helix screw anchors shall be provided in marshy ground; rock anchors shall be installed in rock at right angles to guys, elsewhere anchors shall be of an expanding type, except that power installed screw anchors of equivalent holding power are acceptable. A half-round yellow polyvinyl, fiberglass, or other suitable plastic guy marker, not less than 2.4 m (8 feet) in length, shall be provided at the anchor end of each guy shown, securely clamped to the guy or anchor at the bottom and top of the marker. Holding capacities for down guys shall be based on a lead angle of 45 degrees.

3.5 CONDUCTOR INSTALLATION

3.5.1 Line Conductors

Unless otherwise indicated, conductors shall be installed in accordance with manufacturer's approved tables of sags and tensions. Proper care shall be taken in handling and stringing conductors to avoid abrasions, sharp bends, cuts, kinks, or any possibility of damage to insulation or conductors. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor shall not be less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors shall be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension shall be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation as recommended by the manufacturer.

3.5.2 Connectors and Splices

Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors.

Aluminum-composition conductors shall be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type. Noninsulated connectors shall be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.5.3 Conductor-To-Insulator Attachments

Conductors shall be attached to insulators by means of clamps, shoes or tie wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as indicated in TABLE II.

TABLE II

TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8
4 and 2	6
1 through 3/0	4
4/0 and larger	2
AAC, AAAC, or ACSR (AWG)	**AAAC OR AAC (AWG)**
Any size	6 or 4

3.5.4 Armor Rods

Armor rods shall be provided for AAAC conductors. Armor rods shall be installed at supports, except armor rods will not be required at primary dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods shall be in accordance with the manufacturer's recommendations. For span lengths of less than 61 m, flat aluminum armor rods may be used. Flat armor rods, not less than 762.0 micrometers by 6.4 mm (0.03 by 0.25 inch) shall be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods shall be not less than 1.3 by 7.6 mm (0.05 by 0.30 inches). For span lengths of 61 m or more, preformed round armor rods shall be used.

3.5.5 Medium-Voltage Insulated Cables

Medium-voltage cable messengers shall be attached to poles with clamps providing a strength exceeding the required messenger strength and with not

less than 15.9 mm (5/8 inch) through-bolts. Messengers shall be dead-ended, grounded, and storm and line-guyed at corners and dead-ends, and at intervals not exceeding 305 m along straight runs.

3.5.6 Low-Voltage Insulated Cables

Low-voltage cables shall be supported on clevis fittings using spool insulators. Dead-end clevis fittings and suspension insulators shall be provided where required for adequate strength. Dead-end construction shall provide a strength exceeding the rated breaking strength of the neutral messenger. Clevis attachments shall be provided with not less than 15.9 mm (5/8 inch) through-bolts. Secondary racks may be used when installed on wood poles and where the span length does not exceed 61 m. Secondary racks shall be two-, three-, or four-wire, complete with spool insulators. Racks shall meet strength and deflection requirements for heavy-duty steel racks, and shall be either galvanized steel or aluminum alloy. Tops of insulator saddles shall be rounded and smooth to avoid damage to conductor insulation. Each insulator shall be held in place with a 15.9 mm (5/8 inch) button-head bolt equipped with a nonferrous cotter pin, or equivalent, at the bottom. Racks for dead-ending four No. 4/0 AWG or four larger conductors shall be attached to poles with three 15.9 mm (5/8 inch) through-bolts. Other secondary racks shall be attached to poles with at least two 15.9 mm (5/8 inch) through-bolts. Minimum vertical spacing between conductors shall not be less than 200 mm.

3.6 NOT USED

3.7 CONNECTIONS TO UTILITY LINES

The Contractor shall coordinate the work with the Contracting Officer and shall provide for final connections to the installation electric lines.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to poles by conduit supports spaced not more than 3 m apart and with one support not more than 300 mm from any bend or termination. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the riser conduit or guard. Cables guards shall be secured in accordance with the manufacturers published procedure. Risers shall be equipped with bushings to protect cables. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable.

3.9 CONNECTIONS TO BUILDINGS

3.9.1 Aerial Services

Connections to buildings shall be made at approximately the point indicated and shall be connected to the service entrance conductors. Supports at buildings shall be adequate to withstand required pulls; supports shall not be rated less than 4450 N (1000 pounds). Drip loops shall be formed on conductors at entrances to buildings, cabinets, or conduits.

Service-entrance conduits with termination fittings and conductors within the building, including sufficient slack for connection to aerial service cables, shall conform to the requirements of Section 16415A ELECTRICAL WORK, INTERIOR.

3.9.2 Underground Services

Connections to buildings shall be made at the point indicated and shall be terminated at the service entrance equipment terminals. Cable pulling shall be in accordance with Section 16375A, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Service entrance conduits with termination fittings and conductors within the building shall conform to the requirements of Section 16415A ELECTRICAL WORK, INTERIOR.

3.10 GROUNDING

Noncurrent-carrying metal parts of equipment and conductor assemblies, such as luminaires, medium-voltage cable terminations and messengers, metal poles, operating mechanisms of pole top switches, panel enclosures, transformers, capacitors, recloser frames (cases) and other noncurrent-carrying metal items shall be grounded. Additional grounding of equipment, neutral, and surge arrester grounding systems shall be installed at poles where indicated.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be located approximately 900 mm out from base of the pole and shall be driven into the earth until the tops of the rods are approximately 300 mm below finished grade. Multiple rods shall be evenly spaced at least 3 m apart and connected together 600 mm below grade with a minimum No. 6 bare copper conductor.

b. Pole butt electrodes - Pole butt electrodes shall be installed where indicated, except that this method shall not be the sole grounding electrode at transformer locations. The pole butt electrode shall consist of a coil of at least 4 m of minimum No. 6 bare copper conductor stapled to the butt of the pole.

c. Plate electrodes - Plate electrodes shall be installed in accordance with the manufacturer's instructions and IEEE C2 and NFPA 70.

d. Ground Resistance - The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be up to three, 3 m (10 feet) rods spaced a minimum of 3 m (10 feet) apart, driven perpendicular to grade. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than

48 hours after rainfall, the Contracting Officer shall be notifies immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding Electrode Conductors

On multi-grounded circuits, as defined in IEEE C2, provide a single continuous vertical grounding electrode conductor. Neutrals, surge arresters, and equipment grounding conductors shall be bonded to this conductor. For single grounded or ungrounded systems, provide a grounding conductor for the surge arrester and equipment grounding conductors and a separate grounding conductor for the secondary neutrals. Grounding electrode conductors shall be sized as shown. Secondary system neutral conductors shall be connected directly to the transformer neutral bushings, then connected with a neutral bonding jumper between the transformer neutral bushing and the vertical grounding electrode conductor, as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 600 mm. On metal poles, a preformed galvanized steel strap, 15.9 mm (5/8 inch) wide by 0.853 (22 gauge) minimum by length, secured by a preformed locking method standard with the manufacturer, shall be used to support a grounding electrode conductor installation on the pole and spaced at intervals not exceeding 1.5 m with one band not more than 75 mm from each end of the vertical grounding electrode conductor. Bends greater than 45 degrees in grounding electrode conductor are not permitted.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which

are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes shall be provided.

3.11.4 Medium-Voltage Preassembled Cable Test

After installation, prior to connection to an existing system, and before the operating test, the medium-voltage preassembled cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors at one terminal and connecting grounds or metallic shieldings or sheaths of the cable at the other terminal for each test. Prior to the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 74 for the particular type of cable installed, and shall not exceed the recommendations of IEEE Std 404 for cable joints unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.5 Sag and Tension Test

The Contracting Officer shall be given prior notice of the time schedule for stringing conductors or cables serving overhead medium-voltage circuits and reserves the right to witness the procedures used for ascertaining that initial stringing sags and tensions are in compliance with requirements for the applicable loading district and cable weight.

3.11.6 NOT USED

3.11.7 NOT USED

3.11.8 NOT USED

3.11.9 Operating Tests

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be

submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16375A

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C57.12.21	(1995) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVa and Smaller
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48M	(1994ael) Gray Iron Castings (Metric)

ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 496	(1999) Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Mahhole Sections (Metric)
ASTM D 923	(1997) Sampling Electrical Insulating Liquids
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1	(1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA LA 1	(1992) Surge Arresters
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the

	Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3; 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 1072	(1995; Rev Mar 1998) Medium Voltage Power Cable
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System; G, RE

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

a. Medium-voltage cables and accessories including cable installation plan.

b. Transformers.

c. Surge arresters.

As-Built Drawings; G, RE

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and

changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Nameplates; G, RE

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment; G, RE

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

General Installation Requirements; G, RE

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests; G, RE

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; G, RE

A proposed field test plan, 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests; G, RE

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Cable Installation; G, RE

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Material and Equipment; G, RE

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Joints; G, RE

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications; G, RE

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume

shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Electrical Distribution System; G, RE

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 25 mm in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of liters and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE

1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072 a galvanized steel interlocked tape armor and thermoplastic jacket. Cables shall be manufactured for use in duct applications.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 8 and AEIC CS6. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape or wire shield for each phase. The shield tape or wire shall be sized to meet IEEE C2 requirements for a ground fault availability of 100,000 amperes.

2.4.1.6 Neutrals

Neutral conductors of shall be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.4.1.7 Jackets

Cables shall be provided with a polyethylene jacket. Direct buried cables

shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 NOT USED

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall

include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 635 long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 NOT USED

2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), shall neither slump at a temperature of 150 degrees C (300 degrees F), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48M , Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 75 MPa and a flexural strength of at least 345 MPa. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 POLES AND HARDWARE

Poles and hardware shall be in accordance with Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

2.9 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.9.1 NOT USED

2.9.2 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the radial type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.9.2.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, oil-immersed, current-limiting, bayonet-type fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert.

2.9.2.2 Load-Break Switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

2.9.2.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the less-flammable, liquid-insulated type with

high molecular-weight hydrocarbon. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity.....As shown on plans

Impedance.....5.75%.

Temperature Rise.....65 degrees C.

High-voltage winding.....13200 volts.

High-voltage winding connections.....Delta.

Low-voltage winding.....480Y/27 volts.

Low-voltage winding connections.....Grounded Wye.

2.9.2.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.9.2.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.10 METERING AND PROTECTIVE DEVICES

2.10.1 NOT USED

2.10.2 NOT USED

2.10.3 NOT USED

2.10.4 Instrument Transformers

2.10.4.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.10.4.2 NOT USED

2.10.4.3 NOT USED

2.10.4.4 NOT USED

2.10.4.5 Current Transformers for Kwh and Demand Metering (Low-Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3 through B-0.5, with a minimum RF of 2 at 30 degrees C, with 600-volt insulations, and 10 kV BIL. Provide butyl-molded, window-type current transformers mounted in the current transformer cabinet.

2.10.5 Watthour Meters

Watthour meters shall conform to ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the socket mounted outdoor having a 15 minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than 2-1/2 stators.

2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be intermediate class, rated as shown. Arresters for use at elevations in excess of 1.8 km (6000 feet) above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 19 mm (3/4 inch) in diameter by 3.1 m (10 feet) in length. Sectional type rods may be used.

2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

2.14 PADLOCKS

Padlocks shall comply with Section 08710 DOOR HARDWARE.

2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 50 mm (2 inches) wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 0.254 mm (10 mil) thick, conforming to UL 510.

2.16 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.17 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard routine design and other tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

2.18 FENCING

Fencing shall conform to the requirements of Section 02821 CHAIN LINK FENCE.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially shall conform to the requirements of Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLE INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 6.4 mm (1/4 inch) less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 131 cubic centimeters (8 cubic inches) of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct.

For cable installation in cold weather, cables shall be kept at 10 degrees C (50 degrees F) temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 NOT USED

3.2.4 NOT USED

3.2.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing.

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the

finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) for ducts of less than 80 mm (3 inch) diameter, and 900 mm (36 inches) for ducts 80 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 150 mm (6 inches) in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 1.5 m below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1.2 m on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 150 mm vertically.

3.5.4 Nonencased Direct-Burial

Top of duct lines shall be as shown. Burial depth shall be increased as required to stay a minimum of 150 m below frost line. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least1 50 mm. The first 150 mm layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.5.1 NOT USED

3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of

reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 15 mm above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.5 NOT USED

3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 100 mm of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 100 mm above finished paving or grade and sloped to drain. Edges of concrete pads shall have 20 mm chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 27.5 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200 CONCRETE REINFORCEMENT.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

3.7.3 Fencing

Fencing shall conform to the requirement of and be installed in accordance

with Section 02821 CHAIN LINK FENCE. Fences shall provide working clearances for operation and maintenance in accordance with IEEE C2. The entire space between fences and concrete pads shall be excavated to a minimum depth of 100 mm below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 15 to 40 mm (1/2 to 1-1/2 inches) graded size up to finished gradelines. Space between fences and concrete pads shall be excavated to a minimum depth of 100 mm below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 15 to 40 mm (1/2 to 1-1/2 inches) graded size up to finished gradelines.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in guards to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 3 m apart and with 1 strap not more than 300 mm from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard.

3.8.1 Pole Installation

Pole installation shall be in accordance with Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 1.5 m outside of a building and 600 mm below finished grade as specified and provided under Section 16415 ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, to the ground. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 300 mm below finished grade.

c. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 300 mm, plus or minus 75 mm, below finished top of soil grade. Ground ring conductors shall be sized as shown.

d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three,3 m apart rods spaced a minimum of 3 m apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall

be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 50 mm above and 150 mm below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.10.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 600 mm of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.10.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 600 mm.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using

the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Multiple rod electrodes - 25 ohms.

c. Ground ring - 25 ohms.

3.11.4 NOT USED

3.11.5 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.11.7 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.11.8 NOT USED

3.11.9 NOT USED

3.11.10 NOT USED

3.11.11 NOT USED

3.11.12 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

b. Pad-mounted transformers

3.11.13 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16415A

ELECTRICAL WORK, INTERIOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.1350	(1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C78.20	(1995) Electric Lamps - Characteristics of Incandescent Lamps A, G, PS, and Similar Shapes with E26 Medium Screw Bases
ANSI C78.21	(1995) Physical and Electrical Characteristics - Incandescent Lamps - PAR and R Shapes
ANSI C78.2A	(1991) 18 & 26- Watt, Compact Fluorescent Quad Tube Lamps **
ANSI C78.2B	(1992) 9 & 13-Watt, Compact Fluorescent Quad Tube Lamps **

ANSI C80.5	(1995) Rigid Aluminum Conduit
ANSI C82.1	(1997) Specifications for Fluorescent Lamp Ballasts \$18.00$\F\X Addenda D & E
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(2000) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.13	(1993) Instrument Transformers
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \$31.00$\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1994) Busways
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems,

	Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1998) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1999) General Requirements for Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
NFPA 70	(2002) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 18	Industrial, Scientific, and Medical Equipment

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts

UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1569	(1999; Rev thru Jan 2000) Metal-Clad Cables
UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Nov 1999) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Jan 1999) Attachment Plugs and Receptacles
UL 5	(1996) Surface Metal Raceways and Fittings
UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 506	(1994; R Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment

UL 512	(1993; Rev thru Mar 1999) Fuseholders
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 514C	(1996; Rev thru Dec 1999) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1999) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 67	(1993; Rev thru Oct 1999) Panelboards
UL 698	(1995; Rev thru Mar 1999) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 844	(1995; Rev thru Mar 1999) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev thru Nov 1999) Motor Control Centers
UL 857	(1994; Rev thru Dec 1999) Busways and Associated Fittings
UL 869A	(1998) Reference Standard for Service Equipment
UL 877	(1993; Rev thru Nov 1999) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified)

	Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 916	(1998) Energy Management Equipment
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 935	(1995; Rev thru Oct 1998) Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru May 1998) Ground-Fault Circuit-Interrupters
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL Elec Const Dir	(1999) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to

NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 NOT USED

1.2.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 6.4 mm High Letters	Minimum 3.2 mm High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers
Transformers	
Equipment Enclosures	
Switchboards	
Motors	

Each panel, section, or unit in motor control centers, switchgear or

similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.2.7 Recessed Light Fixtures (RLF) Option

The Contractor has the option to substitute inch-pound (I-P) RLF to metric RLF. This option shall be coordinated with Section 09510A ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Interior Electrical Equipment; G, RE.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

a. Transformers.

b. Battery system including calculations for the battery and charger.

c. Busway systems.

d. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

e. Sway bracing for suspended luminaires.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

SD-03 Product Data

As-Built Drawings; G, RE.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be

added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G, RE.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; G, RE.

Six copies of the information described below in 216 x 280 mm binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Field Test Plan; G, RE.

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; G, RE.

Six copies of the information described below in 216 x 280 mm binders having a minimum of 5 rings from which material may

readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The conditions specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

SD-07 Certificates

Materials and Equipment; G, RE.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 BUSWAYS

UL 857. Busses shall be copper. Enclosures shall be steel. Short-circuit ratings, except as indicated, shall be in accordance with NEMA BU 1.

2.1.1 Feeder Busways

Feeder busways shall be ventilated, except that vertical busways within 1.8 meters of floors shall be unventilated low-impedance busway.

2.2 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.2.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.2.2 Aluminum Conductors

Aluminum conductors shall not be used.

2.2.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.2.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.2.5 Metal Clad Cable

UL 1569, NFPA 70, Type MC Cable.

2.3 CABLE TRAYS

Cable tray shall conform to NEMA VE 1, shall form a wireway system, and shall be of nominal 150 mm depth. Cable trays shall be constructed of copper-free aluminum. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 915 mm. Load class designation 8C.

2.3.1 NOT USED

2.3.2 Ladder

Ladder-type cable trays shall be of nominal 300 mm width. Rung spacing shall be on 230 mm maximum centers.

2.4 NOT USED

2.5 NOT USED

2.6 CIRCUIT BREAKERS

2.6.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489and UL 877 for circuit breakers and circuit breaker enclosures located in hazardous (classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.6.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible. All breakers shall be capable of being locked in the open or closed position.

2.6.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.6.1.3 NOT USED

2.6.1.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.6.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

e. Short-time I square times t switch.

f. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

g. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but not greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap will not be permitted.

h. Adjustable ground-fault delay.

i. Ground-fault I square times t switch.

j. Overload and short-time and ground-fault trip indicators shall be provided.

2.6.3 Current-Limiting Circuit Breakers

Current-limiting circuit breakers shall be provided as shown. Current-limiting circuit breakers shall limit the let-through I square times t to a value less than the I square times t of one-half cycle of the symmetrical short-circuit current waveform. On fault currents below the threshold of limitation, breakers shall provide conventional overload and short-circuit protection. Integrally-fused circuit breakers shall not be used.

2.6.4 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.6.5 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.6.6 NOT USED

2.6.7 NOT USED

2.6.8 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.7 NOT USED

2.8 CONDUIT AND TUBING

2.8.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.8.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.8.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.8.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.8.5 Intermediate Metal Conduit

UL 1242.

2.8.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.8.7 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.8.8 Rigid Metal Conduit

UL 6.

2.8.9 Rigid Plastic Conduit

NEMA TC 2, UL 651 and UL 651A.

2.8.10 Surface Metal Electrical Raceways and Fittings

UL 5.

2.9 CONDUIT AND DEVICE BOXES AND FITTINGS

2.9.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.9.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.9.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.9.4 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.9.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.9.6 Fittings For Use in Hazardous (Classified) Locations

UL 886.

2.9.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.10 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.11 CONNECTORS, WIRE PRESSURE

2.11.1 For Use With Copper Conductors

UL 486A.

2.11.2 For Use With Aluminum Conductors

UL 486B.

2.12 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.12.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 19.1 mm in diameter by 3.1 meter in length of the sectional type driven full length into the earth.

2.12.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.13 ENCLOSURES

NEMA ICS 6 or NEMA 250 or UL 698 for use in hazardous (classified) locations, unless otherwise specified.

2.13.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 0.0164 cubic meters shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.13.2 Circuit Breaker Enclosures

UL 489.

2.14 LIGHTING FIXTURES, LAMPS, BALLASTS, EMERGENCY EQUIPMENT, CONTROLS AND

ACCESSORIES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lighting equipment installed in classified hazardous locations shall conform to UL 844. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

2.14.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992.

a. Incandescent and tungsten halogen lamps shall be designed for 125 volt operation (except for low voltage lamps), shall be rated for minimum life of 2,000 hours, and shall have color temperature between 2,800 and 3,200 degrees Kelvin. Tungsten halogen lamps shall incorporate quartz capsule construction. Lamps shall comply with ANSI C78.20 and sections 238 and 270 of ANSI C78.21.

b. Fluorescent lamps shall be green-tipped and shall have color temperature as shown. They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer to provide for color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts	(4' lamp)	2800 lumens
T12,34 watts	(4' lamp)	2800 lumens
T8,59 watts	(8' lamp)	5700 lumens
T12,60 watts	(8' lamp)	5600 lumens
T8/U,31-32 watts	(U-tube)	2600 lumens
T12/U,34 watts	(U-tube)	2700 lumens

(1) Linear fluorescent lamps, unless otherwise indicated, shall be 1219 mm long 32 watt T8, 265 mA, with minimum CRI of 75. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on rapid start ballasts.

(2) Small compact fluorescent lamps shall be twin, double, or triple tube configuration as shown with bi-pin or four-pin snap-in base and shall have minimum CRI of 85. They shall deliver rated life when operated on ballasts as shown. 9 and 13 watt double tube lamps shall comply with ANSI C78.2B. 18 and 26 watt double

tube lamps shall comply with ANSI C78.2A. Minimum starting temperature shall be 0 degrees C for twin tube lamps and for double and triple twin tube lamps without internal starter; and -9 degrees C for double and triple twin tube lamps with internal starter.

(3) Long compact fluorescent lamps shall be 18, 27, 39, 40, 50, or 55 watt bi-axial type as shown with four-pin snap-in base; shall have minimum CRI of 85; and shall have a minimum starting temperature of 10 degrees C . They shall deliver rated life when operated on rapid start ballasts.

c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -29 degrees C . Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355,ANSI C78.1375, and ANSI C78.1376.

2.14.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

a. Low voltage incandescent transformers shall be Class II UL listed 120/12 volt or 120/24 volt step-down transformers as required for the lamps shown. Transformers shall be high power factor type and shall be rated for continuous operation under the specified load. Transformers shall be encased or encased and potted, and mounted integrally within the lighting fixture unless otherwise shown.

b. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 25 degrees C above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be

mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 25 degrees C above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 277 volts at 60 Hz and maintain constant light output over a line voltage variation of ± 10%. Ballasts shall have an end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 10 degrees C. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum $10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid start linear & U-tubes	120 or 277 V	1	2.54
			2	1.44
			3	0.93
			4	0.73
34W T12	rapid start linear & U-tubes	120 or 277 V	1	2.64
			2	1.41
			3	0.93
59W T8	rapid start linear	120 or 277 V	2	0.80
60W T12	rapid start linear	120 or 277 V	2	0.80

(3) Magnetic fluorescent ballasts shall be energy-saving, automatic resetting type, approved for the application by the Certified Ballast Manufacturers and complying with ANSI C82.1 and UL 935. Minimum ballast starting temperature shall be 4.4 degrees C for normal service and -18 degrees C where cold temperature service is required. Magnetic fluorescent ballasts shall have a ballast factor not less than shown in the following table:

MAGNETIC FLUORESCENT BALLAST FACTORS*

Design starting temperature above 4.4 degrees C with 60 Hz input frequency

LAMP TYPE	NUMBER OF LAMPS	NOMINAL OPERATIONAL INPUT VOLTAGE	TYPE OF STARTER & LAMP	MIN. BALLAST FACTOR
25W F25T8	1	120v	rapid start	.96
	1	277v		.96
	2	120v		.95
	2	277v		.94
32W F32T8	1	120v	rapid start	.96
	1	277v		.95
	2	120v		.85
	2	277v		.96
96W F96T8	1	120 or 277v	instant start	1.10
	2			.85

* For ballasts not specifically designed for use with dimming controls.

c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 25 degrees C above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of -18 degrees C .

(2) Magnetic high intensity discharge ballasts shall have a minimum starting temperature of -29 degrees C .

2.14.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum

wall thickness of 3 mm . Plastic lenses shall be 100% virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type. Conoid recessed reflector cones shall be Alzak with clear specular low iridescent finish.

a. Incandescent fixtures shall comply with UL 1571. Incandescent fixture specular reflector cone trims shall be integral to the cone and shall be finished to match. Painted trim finishes shall be white with minimum reflectance of 88%. Low voltage incandescent fixtures shall have integral step-down transformers.

b. Fluorescent fixtures shall comply with UL 1570. Recessed ceiling fixtures shall comply with NEMA LE 4. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Fluorescent fixture lens frames on recessed and surface mounted troffers shall be one assembly with mitered corners. Parabolic louvers shall have a low iridescent finish and 45 degree cut-off. Louver intersection joints shall be hairline type and shall conceal mounting tabs or other assembly methods. Louvers shall be free from blemishes, lines or defects which distort the visual surface. Integral ballast and wireway compartments shall be easily accessible without the use of special tools. Housings shall be constructed to include grounding necessary to start the lamps. Open fixtures shall be equipped with a sleeve, wire guard, or other positive means to prevent lamps from falling. Medium bi-pin lampholders shall be twist-in type with positive locking position. Long compact fluorescent fixtures and fixtures utilizing U-bend lamps shall have clamps or secondary lampholders to support the free ends of the lamps.

c. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.

d. Emergency lighting fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes. Batteries shall be Nicad or equal with no required maintenance, and shall have a minimum life expectancy of five years and warranty period of three years.

e. Exit Signs

Exit signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m^2 measured at normal (0 degree) and 45 degree viewing angles. Minimum luminance shall be greater than 8.6 cd/m^2 measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years.

2.14.4 Lampholders, Starters, and Starter Holders

UL 542

2.14.5 Ultrasonic, and Passive Infrared Occupancy Sensors

UL 916

2.15 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.15.1 NOT USED

2.15.2 NOT USED

2.15.3 NOT USED

2.15.4 NOT USED

2.15.5 Fuses, Class R

UL 198E.

2.15.6 NOT USED

2.15.7 NOT USED

2.15.8 NOT USED

2.15.9 Fuseholders

UL 512.

2.16 NOT USED

2.17 NOT USED

2.18 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.18.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200

percent of rated current.

2.18.2 Motor Starters

Combination starters shall be provided with fusible switches, and switches equipped with high-interrupting-capacity current-limiting fuses as indicated.

2.18.3 Thermal-Overload Protection

Each motor of 93 W (1/8 hp) or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.18.4 Low-Voltage Motor Overload Relays

2.18.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds.

2.18.4.2 Construction

Manual reset type thermal relay shall be bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.18.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 10 degrees C, an ambient temperature-compensated overload relay shall be provided.

2.19 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.20 RECEPTACLES

2.20.1 NOT USED

2.20.2 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

2.20.3 Standard Grade

UL 498.

2.20.4 Ground Fault Interrupters

UL 943, Class A or B.

2.20.5 NOT USED

2.20.6 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 20-Ampere, 125 Volt

20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

b. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

c. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R, locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R, locking: NEMA type L15-30R.

d. 50-Ampere, 250 Volt

Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

2.21 Service Entrance Equipment

UL 869A.

2.22 SPLICE, CONDUCTOR

UL 486C.

2.23 SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose ventilated

type in accordance with NEMA PB 2, UL 891, and IEEE C37.20.1 and shall be installed to provide front and rear access. Busses shall be copper. Assembly shall be approximately 2.3 meters high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the switchboards and circuit breakers and fuses shall be based on the maximum fault current available.

2.23.1 Circuit Breakers

Circuit breakers shall be molded-case circuit breakers.

2.24 HIGH PRESSURE CONTACT SWITCHES (HPC)

2.24.1 General

HPC switches are UL listed in accordance with Standard 977, Fused Power Circuit Devices (UL File No. E51827). The over-center toggle mechanism provides stored energy, quick-make/quick-break operation. Multiple spring-loaded high pressure current-carrying contact arms and an arcing contact arm provide excellent current-carrying capability without sacrificing high interrupting fault performance. Switches are 100 percent rated and can interrupt, on a make and break basis, a minimum of 12 times their nameplate rating without fuse assistance at 600 volts ac. Complete HPC switch and Class L fuse coordination is therefore achieved for all levels of fault current up to 200,000 rms amperes symmetrical at 600 volts ac maximum. Type HPC switches used as service disconnects comply with the National Electrical Code Article 230-65 and Article 230-95 for adequate short circuit current and ground fault protection. HPC switches with integral ground fault protection, when provided with 120 volts ac external control power, permit compliance with NEC Article 230-95 (c), which requires ground fault protection system testing when first installed.

2.24.2 High-Durability - Safety of Operation

High-dielectric strength, glass reinforced insulating case.

2.24.3 High Interrupting Capability

Arc chute of unique construction suppresses arcs and cools gases rapidly, providing quick arc interruption and extended switch life.

2.24.4 High Transient Voltage Withstandability

Interphase partitions mesh with switch cover to completely isolate each pole.

2.24.5 Extended Switch Life

Preloaded constant pressure pivot eliminates braid whip and fraying on high short circuit currents and repeated operations.

2.24.6 Positive "On-Off" Indication

Green (Off), Red (On), eliminates any question about the position of the

switch contacts.

2.24.7 Easy Operation - Quick Make

Extra heavy duty, low torque rotary operated closing mechanism. L-handle 800-1600A. T-handle 2000-4000A.

2.24.8 Emergency Open - Quick Break

Finger-tip "Off" button instantly opens the switch contacts.

2.24.9 Positive Door and Switch Interlocking

Separate fuse access door is not required.

2.24.10 Top Feed

Line terminals at top of switch.

2.24.11 Bottom Feed

Line terminals at bottom of switch; fuses are de-energized when switch is in off position. Same size as top feed.

2.24.12 Integral Ground Fault

Incorporating a solid-state, inverse time and fixed time response. Ground fault function shall be self-powered and has field adjustable ground fault current and delay time settings for maximum coordination and selectivity.

2.25 NOT USED

2.26 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings, except as indicated. "T" connections may be used for transformers rated 15 kVA or below. Transformers supplying non-linear loads shall be UL listed as suitable for supplying such loads with a total K-factor not to exceed K-13 and have neutrals sized for 200 percent of rated current.

2.26.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated. Transformers shall be provided in NEMA 1 enclosure for indoors. Outdoor transformer shall be stainless steel, non-ventilated, sealed with NEMA 3R rating. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.27 NOT USED

2.28 NOT USED

2.29 NOT USED

2.30 NOT USED

2.31 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 1.8 meters on centers, may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 100 mm above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions

and/or alterations.

3.1.3 Grounding Conductors

All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in electrical metallic tubing. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Metallic armored cables may be installed in areas permitted by NFPA 70. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 21 mm. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may only be used in damp, wet or corrosive locations inside when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) shall be installed within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Penetrations of above grade floor slabs, time-rated partitions and fire walls shall be firestopped in accordance with Section 07840A FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 150 mm away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed

within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 15 meters in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 45 meters in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 1.4 MPa (200 psi) tensile strength. Not less than 254 mm of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 150 mm above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.254 mm thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 NOT USED

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Metallic conduits and tubing,and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 3 meters

and within 900 mm of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 3 meters.

3.2.1.9 NOT USED

3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 15 meters for 15 mm and 20 mm sizes, and 30 meters for 25 mm or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 25 mm (1 inch) size or larger shall not be less than ten times the nominal diameter.

3.2.2 Busway Systems

Busway systems shall be of the voltage, capacity, and phase characteristics indicated. Vertical runs of busways within 1.8 meters of the floor shall have solid enclosures. Busways shall be supported at intervals not exceeding 1.5 meters, and shall be braced properly to prevent lateral movement. Busways penetrating walls or floors shall be provided with flanges to completely close wall or floor openings.

3.2.3 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 1.8 meter intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 250 mm from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 103 mm (4 inch) rigid steel conduits with grounding bushings, extending 300 mm beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section 07840A FIRESTOPPING.

3.2.4 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.4.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 30 meters long and of 277 volts more than 70 meters long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.4.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.4.3 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 1.2 meters above floors shall be protected from mechanical injury by installation in conduit or tubing.

3.2.4.4 NOT USED

3.2.4.5 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

b. Greater Than 600 Volt: Cable splices shall be made in accordance with the cable manufacturer's recommendations and Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.2.4.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).

120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 75 mm of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 1.2 meters above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 600 mm. The total combined area of all box openings in fire rated walls shall not exceed 0.0645 square meters per 9.3 square meters. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 102 mm square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 2.4 mm wall thickness are acceptable. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 38.1 mm (1-1/2 inches) into reinforced-concrete beams or more than 19.1 mm (3/4 inch) into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 25 mm long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 300 mm long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 6 mm from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 600 mm from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of

zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of steel with baked enamel finish or impact-resistant plastic and shall be ivory. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1.6 mm. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 NOT USED

3.5.3 Floor Outlets

Floor outlets shall be adjustable and each outlet shall consist of a cast-metal body with threaded openings for conduits, adjustable ring, and cover plate with 15 mm or 20 mm threaded flush plug. Each telephone outlet shall consist of a horizontal cast housing with a receptacle as specified. Gaskets shall be used where necessary to ensure a watertight installation. Plugs with installation instructions shall be delivered to the Contracting Officer at the job site for capping outlets upon removal of service fittings.

3.5.4 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.4.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.4.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

3.5.5 NOT USED

3.5.6 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be ivory molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

3.5.7 NOT USED

3.5.8 Receptacles, 30-Ampere, 250-Volt

Receptacles, single, 30-ampere, 250-volt, shall be molded-plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.9 NOT USED

3.5.10 Receptacles, 50-Ampere, 250-Volt

Receptacles, single, 50-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.11 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall

switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120 or 277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

3.8.1 NOT USED

3.8.2 Panelboards

Panelboards shall be circuit breaker equipped as indicated on the drawings. Switches serving as motor disconnect means shall be horsepower rated in conformance with UL 98.

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as shown or specified.

3.9.1 NOT USED

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1 shall have tested

interrupting capacity not less than 100,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9.4 Continuous Current Ratings (Greater than 600 Amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 1.5 m beyond the building wall and 600 mm below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.11 NOT USED

3.12 NOT USED

3.13 MOTOR CONTROL

Each motor or group of motors requiring a single control and not controlled from a motor-control center shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 93 W (1/8 hp) or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for

that purpose and have an adequate kilowatt rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.13.1 NOT USED

3.13.2 NOT USED

3.13.3 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.13.4 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.14 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.15 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye or wye-delta configuration as indicated. "T" connections may be used for

transformers rated at 15 kVA or below. Dry-type transformers shown located within 1.5 meters of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the building may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

3.16 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.16.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.16.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.16.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

3.16.2.2 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling, in conformance withUL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the ceiling panel structural supports.

3.16.2.3 Fixtures for Installation in Grid Type Ceilings

Fixtures for installation in grid type ceilings which are smaller than a full tile shall be centered in the tile. 305 by 1219 mm fixtures shall be mounted along the grid rail as shown. Work above the ceiling shall be coordinated among the trades to provide the lighting layout shown. Fixtures mounted to the grid shall have trim exactly compatible with the grid. Contractor shall coordinate trims with ceiling trades prior to ordering fixtures. Metric fixtures shall be designed to fit the metric grid specified. Fixtures in continuous rows shall be coordinated between trades prior to ordering. Fixtures shall be mounted using independent supports capable of supporting the entire weight of the fixture. No fixture shall rest solely on the ceiling grid. Recessed fixtures installed in seismic areas should be installed utilizing specially designed seismic clips. Junction boxes shall be supported at four points.

3.16.2.4 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers or hand-straights so that they hang plumb. Pendants, rods, or chains 1.2 meters or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degrees of separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 3.1 meters or as recommended by the manufacturer, whichever is less.

Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

3.16.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.16.4 Emergency Light Sets

Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

3.17 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.18 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 2 m or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.18.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.18.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and terminated.

3.18.3 Food Service Equipment Provided Under Other Sections

Wiring shall be extended to the equipment and terminated.

3.19 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.20 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTS AND COATINGS.

3.21 NOT USED

3.22 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.22.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.22.2 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

3.22.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 8 hours before the site is ready for inspection.

3.22.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 304.8/(length of cable in meters)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.22.4.1 NOT USED

3.22.4.2 Low Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

3.22.5 Metal Enclosed Bus Duct Tests

a. Insulation Resistance phase-to-phase, all combinations.

b. Insulation resistance phase-to-ground, each phase.

c. AC or DC high-potential test.

d. Phase rotation test.

3.22.6 NOT USED

3.22.7 NOT USED

3.22.8 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers.

a. Insulation resistance test phase-to-ground, each phase.

b. Turns ratio test.

3.22.9 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.22.9.1 NOT USED

3.22.9.2 NOT USED

3.22.9.3 Circuit Breakers, Molded Case

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Closed breaker contact resistance test.

d. Manual operation of the breaker.

3.22.10 NOT USED

3.22.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.23 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.24 FIELD SERVICE

3.24.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training shall be submitted.

3.25 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16475

TRANSIENT VOLTAGE SURGE SUPPRESSION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.2 SUMMARY

This Section includes transient voltage surge suppressors for low-voltage power (< 600 Volts) equipment.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Data; G, RE.

For each type of product indicated. Include rated operating voltage, rated capacities, operating temperature, shipping and installed weights, and items per Section 2: Products.

SD-09 Product Certifications

Certifications; G, RE.

Signed by manufacturers of transient voltage suppression devices, certifying that products furnished comply with the following testing and labeling requirements:

UL 1449 and UL 1283, 2nd Edition Listing and classifications

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual; G, RE.

Transient voltage suppression devices to include installation instructions, operation and maintenance manuals specified in Division 1.

SD-11 Field Test Reports

Reports; G, RE.

Written reports of tests specified in Part 3 of this Section. Include the following:

a. Test procedures used.

b. Test results that comply with requirements

c. Failed test results and corrective action taken to achieve requirements.

1.4 QUALITY ASSURANCE

Product must be made by a company engaged in the manufacture of such devices for a minimum of ten years.

1.4.1 Source Limitations

Obtain all suppression devices from a single manufacturer.

1.4.2 Electrical Components, Devices and Accessories

Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4.3 IEEE Compliance

Comply with ANSI/IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits" and test devices in accordance with ANSI/IEEE C62.45, "IEEE Guide for Surge Suppressor Testing".

1.4.4 NEMA Compliance

Comply with NEMA LS-1 "Low Voltage Surge Protective Devices".

1.4.5 UL Compliance

Listed to UL 1449, 2nd Edition "Transient Voltage Surge Suppressors". Shall be UL listed. UL 1283 Certification for Standards for Electromagnetic Interference Filters.

1.5 PROJECT CONDITIONS

1.5.1 Placing into Service

Do not energize or connect service entrance equipment or panelboards to their sources until the surge protective devices are installed and connected. Do not single phase, hi-pot or meggar Service Entrance Equipment without disconnecting the surge protective device, as damage may result from these procedures to the surge protective device.

1.5.2 Service Conditions

Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:

a. Maximum Continuous Operating Voltage: Not less than 125 % of nominal system operating voltage for 120/208 VAC Wye systems, Not less than 115 % for 277/480 VAC Wye.

b. Operating Temperature: -40 to +185 degrees F (-40 to +85 degrees C)

c. Humidity: 0 to 95 %, noncondensing.

d. Altitude: Less than 20,000 feet (6,000 m) above sea level.

1.6 COORDINATION

Coordinate location of field mounted surge suppressors to allow adequate clearances for maintenance, per NEC and all local electrical codes.

1.7 WARRANTY

1.7.1 General Warranty

Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.7.2 Special Warranty

Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within five years (60 months) from date of Substantial Completion, 66 months from date of manufacture. Warranty shall include parts and labor.

PART 2 PRODUCTS

2.1 HARDWIRED TYPE SUPPRESSORS

2.1.1 Surge Protective Device Description

Hardwired type with the following features and accessories:

a. LED indicator lights for power and protective status.

b. Audible alarm, with silencing switch, to indicate when protection has failed.

c. Utilizing metal oxide varistor technology.

d. Internal disconnect switch.

e. Internal fuses rated at a minimum of 200 KA interrupting capacity.

f. Redundant suppression circuits.

g. Including thermal protection for each component, which is continuously monitored.

h. Redundant replaceable modules.

i. Nema 12 style enclosure suitable for indoor installation.

j. Surge event operations center.

k. Flush mounting plate available for flush mount installations.

Single Impulse Surge Current Capacity shall be as follows:

System Configuration	Line to Neutral	Line to Ground	Line to Line	Neutral to Ground
120 / 208 Volt Three Phase Wye	150KA	150KA	150KA	150KA
277 / 480 Volt Three Phase Wye	150KA	150KA	150KA	150KA

UL 1449 Suppressed Voltage Ratings (SVR) as follows:

Mode	120/208 Volt Wye	277/480 Volt Wye
L-N	500 V	1,500 V
L-G	500 V	1,500 V
N-G	400 V	1,500 V
L-L	700 V	1,500 V

PART 3 EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

Install devices at service entrance, distribution panels, and panelboards as indicated on electrical one-line drawings.

Provide multi-pole, 100 Amp breaker as a dedicated disconnect for the suppressor at Service Entrance location.

Install devices per manufacturer's instructions with conductors between suppressor and points of attachment as short and as straight as possible. Do not mount internal to switchgear to facilitate ease of future maintenance and/or replacement.

3.2 CONNECTIONS

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Perform the following field quality control testing:

a. After installing the surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.

b. Complete start-up checks and voltage verifications according to manufacturer's written instructions.

c. Perform visual and mechanical inspection on each unit. Certify that units are installed per manufacturer's recommendations.

Repair or replace malfunctioning units. Retest after repairs or replacements are made.

-- End of Section --

SECTION 16528

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-3	(1994) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C135.1	(1979) Galvanized Steel Bolts and Nuts for Overhead Line Construction
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction
ANSI C136.2	(1996) Luminaires, Voltage Classification Roadway Lighting Equipment
ANSI C136.3	(1995) Roadway Lighting Equipment-Luminaire Attachments
ANSI C136.6	(1997) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies -

	Mechanical and Optical Interchangeability
ANSI C136.9	(1990) Roadway Lighting - Socket Support Assemblies for Use in Metal Heads - Mechanical Interchangeability
ANSI C136.10	(1996) Roadway Lighting- Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
ANSI C136.11	(1995) Multiple Sockets for Roadway Lighting Equipment
ANSI C136.15	(1986) Roadway Lighting, High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaires -
ANSI C136.20	(1990) Roadway Lighting Equipment - Fiber Reinforced Plastic (FRP) Fiber Lighting Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 575	(1996) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(1983; R 1993) Roadway Lighting

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

IEEE C136.13	(1987; R 1997) Metal Brackets for Wood Poles
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(1997; Rev Mar 1999) Rubber-Insulated Wires and Cables
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL 467	(1993; Rev Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 514A	(1996; R Jul 1998) Metallic Outlet Boxes
UL 514B	(1996; R Oct 1998) Fittings for Conduit and Outlet Boxes
UL 514C	(1996; R Sep 1998) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1571	(1995; Rev thru Jun 1997) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 1997) High Intensity Discharge Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting System; G, RE
Detail Drawings; G, RE

Detail drawings for the complete system and for poles, lighting fixtures, bracket arms, and handholes.

Include dimensions, effective projected area EPA, accessories, pad installation, and construction details. Photometric data, include zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.

As-Built Drawings; G, RE

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

SD-03 Product Data

Equipment and Materials; G, RE

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

SD-10 Operation and Maintenance Data

Lighting System; G, RE

A draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

1.3 SYSTEM DESCRIPTION

1.3.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.4 CORROSION PROTECTION

1.4.1 NOT USED

1.4.2 Ferrous Metal Materials

1.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

1.4.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B

117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 BRACKET ARMS

2.2.1 On Fiberglass Poles

Poles shall be provided with bracket arms of the support arm style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.2.2 NOT USED

2.2.3 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.3 CABLE

The Contractor shall provide all wire and cable. Wire and cable components shall be able to withstand the jobsite environment for a minimum of 20 years.

2.3.1 Insulated Cable

Cable shall be type USE conforming to UL 854, with copper conductors and type RHW or XHHW insulation conforming to UL 44, and shall include green ground conductor. Cable shall be provided with insulation of a thickness

not less than that given in column A of TABLE 15.1 of UL 854. Cable shall be rated 600 volts. Parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded.

2.4 NOT USED

2.5 CABLE SPLICES AND CONNECTORS

Cable splices and connectors shall conform to UL 486A. Underground splices and connectors shall also conform to the requirements of ANSI C119.1.

2.6 CABLE BOXES

Boxes and covers shall be made of cast iron with zinc coated or aluminized finish, and shall be of the sizes indicated on drawings. The minimum inside dimensions shall be not less than 304.8 mm (12 inches) square by 152.4 mm (6 inches) deep and not less than required to house the cable splice. A suitable gasket shall be installed between the box and cover for watertightness. A sufficient number of screws shall be installed to hold the cover in place along the entire surface of contact. Grounding lugs shall be provided.

2.7 NOT USED

2.8 CONDUIT, DUCTS AND FITTINGS

2.8.1 NOT USED

2.8.2 NOT USED

2.8.3 Conduit Fittings and Outlets

2.8.3.1 Boxes, Metallic Outlets

NEMA OS 1 and UL 514A.

2.8.3.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.8.3.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

UL 886.

2.8.3.4 Boxes, Switch (Enclosed), Surface Mounted

UL 98.

2.8.3.5 Fittings for Conduit and Outlet Boxes

UL 514B.

2.8.3.6 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.8.3.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.8.4 Non-Metallic Duct

Non-metallic duct lines and fittings utilized for underground installation shall be suitable for the application. Duct shall be thick-wall, single, round-bore type. Schedule 40 polyvinyl chloride (PVC) shall conform to UL 651. Plastic utility duct and fittings manufactured without a UL label or listing shall be provided with a certification as follows: "The materials are suitable for use with 75 degree C (167 degrees F) wiring. No reduction of properties in excess of that specified for materials with a UL label or listing will be experienced if samples of the finished product are operated continuously under the normal conditions that produce the highest temperature in the duct."

2.9 NOT USED

2.10 GROUND RODS

Ground rods shall be of copper clad steel conforming to UL 467 not less than 19.1 mm (3/4 inch) in diameter by 3.1 m (10 feet) in length of the sectional type driven full length into earth.

2.11 POLES

Poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity as indicated at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.11.1 Fiberglass Poles

Fiberglass poles shall conform to ANSI C136.20 and shall be designed specifically for supporting luminaires and shall have factory-formed cable entrance and handholes. Resin color shall be dark bronze and pigment shall provide uniform coloration throughout entire wall thickness. Finished surface shall be pigmented polyurethane which may be omitted if the surface layer of the pole is inherently ultra-violet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

2.11.2 NOT USED

2.11.3 NOT USED

2.11.4 NOT USED

2.11.5 NOT USED

2.11.6 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.12 POLE LINE HARDWARE

Zinc coated hardware shall conform to ANSI C135.1 and ANSI C135.14, and steel hardware material shall conform to ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.13 NOT USED

2.14 NOT USED

2.15 NOT USED

2.16 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

2.16.1 NOT USED

2.16.2 NOT USED

2.16.3 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI C78.1375 or ANSI C78.1376. Ballasts shall conform to ANSI C82.4 or UL 1029.

2.17 NOT USED

2.18 NOT USED

2.19 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.20 LIGHTING CONTROL EQUIPMENT

2.20.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock

assembly adjustable operation range of approximately 5.4 to 53.8 lux. Provisions shall be provided for override of photo-switch for timer control only.

2.20.2 Timer Control Switches

Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at a pre-determined time between 2030 hours and 0230 hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise shall be provided. A switch rated 120/277 volts, having battery backed electronic clock to maintain accurate time for a minimum of 7 hours following a power failure shall be provided. A time switch with a manual on-off bypass switch shall be provided. Housing for the time switch shall be a surface mounted, NEMA 1 (indoor) enclosure conforming to NEMA ICS 6.

2.20.3 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120/277 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.20.4 Safety Switches

Switches shall be the heavy-duty type with NEMA ICS 6 Type 1 enclosures and shall be suitable for operation on a 480Y/277 three-phase system. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. Blades shall be visible with door open and shall be of the quick-make, quick-break type. Terminal lugs shall be coordinated with the wire size. Switches shall conform to UL 98.

2.20.5 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for 277 volts, single phase, 60 Hz. Coil voltage shall be 277 volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

2.21 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

2.22 LUMINAIRES, FLOODLIGHTING

2.22.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1572. Incandescent lighting fixtures shall conform to UL 1571.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government. The Contractor shall not take any corrective action without written permission from the Government.

3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.3 PREVENTION OF CORROSION

3.3.1 Aluminum

Aluminum shall not be used in contact with earth or concrete, and where connected to dissimilar metal, shall be protected by approved fittings and treatment.

3.3.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 254 micrometers (0.010 inch) thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 CABLE INSTALLATION

Cable and all parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber or nonferrous metal tags, or approved equal, in each handhole and junction box, and at each terminal.

3.4.1 Splices

Splices below grade shall be made with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Splices above grade shall be made with sealed insulated pressure connectors and shall provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, jackets shall be cut back to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.4.2 Installation in Duct Lines

Ground and neutral conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.4.3 NOT USED

3.4.3.1 Trenching

Trenches shall be excavated to the depths required to provide the minimum cable cover. The bottom of the trench shall be smooth and free of stones and sharp objects. Where the bottom of the trench consists of material other than sand or earth, an additional 75 mm layer shall be removed and replaced by a 75 mm layer of sand or stone-free earth compacted to the approximate density of the surrounding firm soil. The cables shall be unreeled in place along the side of or in the trench and carefully placed on the sand or earth bottom. Pulling cables into a direct-burial trench from a fixed reel position will not be permitted. Where cables cross, a separation of at least 75 mm shall be provided, unless the cables are protected by nonmetallic conduit sleeves at the crossing. The radius of bends in cables shall be not less than 12 times the diameter of the cable. Cables shall not be left under longitudinal tension. The first layer of backfill shall be 150 mm thick and shall consist of sand or stone-free earth. One-inch untreated planks, not less than 200 mm in width, or approved equal protection, shall be placed end to end along the cable run, approximately 75 mm above the cable. A 0.127 mm (5 mil), brightly colored plastic tape not less than 75 mmin width and suitably inscribed at not more than 3 m on centers, or other approved dig-in warning indication, shall be placed approximately 300 mm below finished grade levels of trenches. Selected backfill of sand or stone-free earth shall be provided

to a minimum depth of 75 mm above cables.

3.4.3.2 Requirements for Installation in Duct

Where indicated on drawing, cable shall be installed in duct lines. Ground and neutral conductors shall be installed in duct with the associated phase conductors. The segments of direct-burial cable that cross under new railroad tracks, roads, or paving exceeding 1.5 m in width, shall be installed in plastic, or rubber duct encased in concrete in accordance with paragraph DUCT LINES. Pulling of cable into conduit from a fixed reel position will be permitted. At interfaces with direct-burial cable, the direct-burial cable shall be centered in the entrance to the duct, using an approved waterproof, nonhardening mastic compound to facilitate the centering. Where crossing existing railroad tracks, coated rigid steel conduit shall be installed under the tracks, in lieu of concrete-encased duct, in accordance with paragraph DUCT LINES. Installation shall be in accordance with NFPA 70 and the regulations of the railroad.

3.4.3.3 Location of Cable Splices

Splices in direct-burial cable will not be permitted in runs of 150 m or less or at intervals of less than 150 m in longer runs except as required for taps. Where cable splices in shorter intervals are required to avoid obstructions or damage to the cable, the location shall be as approved. Cable splices shall be installed in cable boxes or concrete handholes.

3.4.3.4 Markers

Cable and cable splice markers shall be located near the ends of cables, at each cable splice, approximately every 120 m along the cable run, and at changes in direction of the cable run. Markers need not be placed along cables laid in relatively straight lines between lighting poles that are spaced less than 120 m apart. Markers shall be placed approximately 600 mm to the right of the cable or cable splice when facing the longitudinal axis of the cable in the direction of the electrical load. The marker shall be concrete with a 28 day compressive strength of 17 MPa (2500 psi) in accordance with Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The letter "C" shall be impressed in the top of each marker.

3.4.3.5 Warning Tape

Direct burial cable shall be placed below a plastic warning tape buried in the same trench or slot. A 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the buried cable, shall be placed approximately 300 mm below finished grade.

3.5 NOT USED

3.6 NOT USED

3.7 NOT USED

3.8 NOT USED

3.9 DUCT LINES

3.9.1 Requirements

Numbers and size of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short radius manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) for ducts of less than 80 mm (3 inches) in diameter, and 900 mm (36 inches) for duct 80 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m (25 feet) shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes.

3.9.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and shall match factory tapers. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.9.3 NOT USED

3.9.4 NOT USED

3.9.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendation for the particular type of duct and coupling selected and as approved.

3.9.5.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4 turn to set the joint tightly.

3.9.6 Concrete

Concrete work shall be as specified in Section 03300 CAST-IN-PLACE

STRUCTURAL CONCRETE. Concrete shall be plain, 17 MPa (2500 psi) at 28 days, except that reinforced concrete shall be 21 MPa (3000 psi) at 28 days. Duct line encasement shall be of monolithic construction. Where a connection is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

3.9.7 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other duct locations that are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.10 NOT USED

3.11 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height as indicated. Electrical cabling shall be provided to the light pole. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

3.11.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. Pole brackets for floodlights shall have the number of tenons indicated, arranged to provide the indicated spread between each tenon. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

3.11.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be 21 MPa (3000 psi) at 28 days.

3.11.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided at all poles. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height

of 3 m above grade. Rigid steel conduit ells shall be provided for wood poles, where required

3.11.4 NOT USED

3.11.5 Aluminum Pole Installation

Poles shall be mounted on cast-in-place. Conduit elbows shall be provided for cable entrances into pole interiors.

3.11.5.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufactures standard, and not less than necessary to meet the pole wind loading and other specified design requirements.

3.12 LIGHTING

3.12.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.13 NOT USED

3.14 LIGHTING CONTROL SYSTEM

3.14.1 Photo-Control

Lighting luminaires shall be controlled in banks by a single photo-control element mounted within each bank.

3.14.2 Time Control Switches

Switches shall be installed with not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.14.3 Manual and Safety Switches

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.14.4 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be

securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.15 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following. Grounding conductors shall be soft-drawn, stranded copper. Ground rods shall be driven into the earth so that after the installation is complete, the top of the ground rod will be approximately 300 mm below finished grade, except in handholes.

3.15.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes shall be up to three, 3 m long rods spaced a minimum of 3 m apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.15.2 Items to be Grounded

Ground conductors, metallic conduits, junction boxes, and noncurrent-carrying metallic parts of equipment shall be grounded. Connections above grade shall be made with solderless connectors, and those below grade shall be made by a fusion-welding process.

3.15.3 Lighting Pole

One ground rod shall be provided at each pole. Bases of metal or concrete lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire. Lighting fixture brackets on wood and concrete poles shall be grounded to a No. 6 AWG bare copper grounding conductor connected to the ground rod.

3.15.4 Handhole

In each handhole, at a convenient point close to the wall, a ground rod shall be driven into the earth before the floor is poured, and approximately 100 mm of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor, and a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall. Connection to ground rods shall be by means of bolted-clamp terminals or by an approved fusion-welding process. Ground wires shall be neatly and firmly attached to handhole walls, and the amount of exposed bare wire shall be held to a minimum.

3.15.5 Metal Cable Boxes

Metal cable boxes for direct-burial cable shall be connected to adjacent ground rods by wires with current-carrying capacities of at least 20 percent of the spliced phase conductors, but not less than No. 6 AWG.

3.16 TESTS

3.16.1 NOT USED

3.16.2 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

3.16.3 Ground Resistance Measurements

The resistance to ground shall be measured by the fall-of-potential method described in IEEE Std 81.

The contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "as-built" drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the lighting system. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the as-built drawings, a representative of the Government will review the as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and shall complete the work as required.

-- End of Section --

SECTION 16710

PREMISES DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

ANSI/TIA/EIA-568-B.2	(Jan 2003) Commercial Building Telecommunications Cabling Standard. Part 2: Balanced Twisted-Pair Cabling Components
ANSI/TIA/EIA-568-B.3	(Apr 2002) Optical Fiber Cabling Components Standard
ANSI/TIA/EIA-606	(May 2002) Administration Standard for Commercial Telecommunications Infrastructure
ANSI/TIA/EIA-607	(Oct 2002) Commercial Building Grounding and Bonding Requirements for Telecommunications

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises
ICEA S-83-596	(1994) Fiber Optic Premises Distribution Cable

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of

0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, noncondensing.

1.4 QUALIFICATIONS

1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.

c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Premises Distribution System; G, RE.

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the

work including clearance for maintenance and operation.

Record Drawings; G, RE.

Record drawings for the installed wiring system infrastructure per ANSI/TIA/EIA-606. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

SD-03 Product Data

Record Keeping and Documentation; G, RE.

Documentation on cables and termination hardware in accordance with ANSI/TIA/EIA-606.

Manufacturer's Recommendations; G, RE.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Test Plan; G, RE.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; G, RE.

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-06 Test Reports

Test Reports; G, RE.

Test reports in booklet form with witness signatures verifying execution of tests. Test results will also be provided on 89 mm diskettes in ASCII format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 14 days after completion of testing.

SD-07 Certificates

Premises Distribution System; G, RE.

Written certification that the premises distribution system complies with the ANSI/TIA/EIA-568-B, ANSI/TIA/EIA-569-A, and ANSI/TIA/EIA-606 standards.

Materials and Equipment; G, RE.

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; G, RE.

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

1.8 RECORD KEEPING AND DOCUMENTATION

1.8.1 Cables

A record of all installed cable shall be provided in hard copy format. The cable records shall include only the required data fields per ANSI/TIA/EIA-606.

1.8.2 Termination Hardware

A record of all installed patch panels and outlets shall be provided in hard copy format per ANSI/TIA/EIA-606. The hardware records shall include only the required data fields per ANSI/TIA/EIA-606.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1 Backbone Cable

Backbone cable shall meet the requirements of ICEA S-80-576 and ANSI/TIA/EIA-568-B.2 for Category 6 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cables shall be rated CMP per NFPA 70.

2.2.2 Horizontal Cable

Horizontal cable shall meet the requirements of ANSI/TIA/EIA-568-B.2-1 for Category 6. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Cables shall be rated CMP per NFPA 70.

2.2.3 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with ANSI/TIA/EIA-568-B.2-1.

2.2.3.1 Telecommunications Outlets

Wall and desk outlet plates shall come equipped as indicated. Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of ANSI/TIA/EIA-568-B.2. Modular jack pin/pair configuration shall be T568A per ANSI/TIA/EIA-568-B.2. Faceplates shall be provided and shall be ivory in color. Mounting plates shall be provided for system furniture and shall match the system furniture in color. Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies in single or double gang covers. The modular jacks shall conform to the requirements of ANSI/TIA/EIA-568-B, and shall be rated for use with Category 6 cable in accordance with ANSI/TIA/EIA-568-B and shall meet the Link Test parameters as listed in TIA/EIA TSB 67 and supplemented by ANSI/TIA/EIA-568-B.

2.2.3.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear

mounted type 110 insulation displacement connectors, arranged in rows or columns on 480 mm (19 inch) rack mounted panels. Jack pin/pair configuration shall be T568A per ANSI/TIA/EIA-568-B.2. Panels shall be labeled with alphanumeric x-y coordinates. The modular jacks shall conform to the requirements of ANSI/TIA/EIA-568-B.2, and shall be rated for use with Category 6 cable in accordance with ANSI/TIA/EIA-568-B.2 and shall meet the Link Test parameters as listed in ANSI/TIA/EIA-568-B.

2.2.3.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568A patch panel jack wiring per ANSI/TIA/EIA-568-B.2. Patch cords shall be factory assembled. Patch cords shall conform to the requirements of ANSI/TIA/EIA-568-B.2-1 for Category 6.

2.2.3.4 Terminal Blocks

Terminal blocks shall be wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of ANSI/TIA/EIA-568-B.2, and shall be rated for use with Category 6 cable in accordance with ANSI/TIA/EIA-568-B.2 and shall meet the Link Test parameters as listed in ANSI/TIA/EIA-568-B. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.3 COAXIAL CABLE SYSTEM

The coaxial cable shall be RG6 tri-shield drop cable, NEC coded CATV, as manufactured by COMMSCOPE or equal. Coaxial cables terminating at the TV cabinets shall be labeled indicating each room number the cable serves. Cable shall be rated CMP per NFPA 70. Provide type BNC connectors at each end of cable.

2.4 NOT USED

2.5 FIBER OPTIC CABLE SYSTEM

2.5.1 Backbone Cable

2.5.1.1 Multimode

Multimode fiber optic backbone cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B.3 and ICEA S-83-596 for 50/125 micrometer multimode graded index optical fiber cable. Numerical aperture for each fiber shall be a minimum of 0.275. Cable construction shall be tight buffered type. Individual fibers shall be color coded for identification. Cable shall be imprinted with fiber count and aggregate length at regular intervals.

Cable shall be rated OFNP per NFPA 70.

2.5.2 Horizontal Distribution Cable

2.5.2.1 Multimode

Multimode fiber optic horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B.3 and ICEA S-83-596 for 50/125 micrometer multimode graded index optical fiber cable. Numerical aperture for each fiber shall be a minimum of 0.275. Cable construction shall be tight buffered type, two strands. Individual fibers shall be color coded for identification. Cable shall be imprinted with fiber count, fiber type, and aggregate length at regular intervals of 1.0 m. Cable shall be rated and marked OFNP per NFPA 70.

2.5.3 Connecting Hardware

2.5.3.1 Connectors

Connectors shall be ST type with ceramic ferrule material with a maximum insertion loss of .5 dB. Connectors shall meet performance requirements of EIA ANSI/TIA/EIA-568-B. Connectors shall be field installable. Connectors shall utilize adhesive for fiber attachment to ferrule. Connectors shall terminate fiber sizes as required for the service. Station cable faceplates shall be provided and shall be ivory in color, impact resistant plastic, single gang or double gang, with double-sided female ST coupler. Mounting plates shall be provided for system furniture and shall match the furniture system in color.

2.5.3.2 Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Patch panels shall be 480 mm (19 inch) rack mounted or wall mounted panels. Patch panels shall provide strain relief for cables. Panels shall be provided with labeling space. Patch panel connectors and couplers shall be the same type and configuration as used elsewhere in the system.

2.5.3.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible optical fiber cable with connectors of the same type as used elsewhere in the system. Optical fiber shall be the same type as used elsewhere in the system. Patch cords shall be complete assemblies from manufacturer's standard product lines.

2.6 EQUIPMENT RACKS

2.6.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be aluminum relay racks with uprights to mount equipment 480 mm (19 inches) wide. Uprights shall be 75 mm deep channel, 32 mm wide, drilled and tapped 12-24 in a 13 mm pattern. Racks

shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 2.1 m in height and clear coated. AC outlets shall be provided as shown.

2.6.2 Wall Mounted Open Frame

Wall mounted open frame equipment racks shall be aluminum relay racks to mount equipment 480 mm (19 inches) wide with standoff brackets for wall mounting. Uprights shall be drilled and tapped 12-24 in a 13 mm pattern. Standoff brackets shall be of sufficient length for a 150 mm clearance between rack and wall. Wall mounted open frame racks shall be hinged. AC outlets shall be provided as shown.

2.6.3 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 480 mm (19 inch) equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

2.7 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or light colored paint.

2.8 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 117 mm square by 53 mm deep with minimum 9 mm deep single or two gang plaster ring as shown. Provide a minimum 25 mm conduit.

2.9 BUILDING ENTRANCE TERMINAL (BET), COPPER

The BET shall consist of a self-contained wall-mounted unit providing a housing for termination of entrance cable, protector modules and access for cross-connecting to horizontal wiring. The BET shall be securely mounted to the communications backboard and connected to the facility ground with a #6 AWG bare copper wire. BET protection capacity shall equal the cable count of the entrance cable.

Protection modules shall be of the three-electrode gas tube type. Protection modules shall be classified as heavy in the categories of impulse life, maximum surge impulse and 60 Hz current carrying capacity as specified in REA TE&CM 823.

2.10 SOLE SOURCE EQUIPMENT

One (1) - Norstar Modular ICS Phone System configured to accept (12) trunks and forty-eight (48) stators.

Thirty-four (34) - Eight (8) button Norstar phone sets.

One (1) - Twenty-four (24) button Norstar phone set.

Three (3) - LS/PS trunk card.

One (1) - Voice gate 6-port voice mail with auto attendant.

One (1) - Norstar remote access device.

One (1) - UPS.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with ANSI/TIA/EIA-606. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840 FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with ANSI/TIA/EIA-568-A and as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance with ANSI/TIA/EIA-606. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Fiber optic cables shall be installed either in conduit or through type cable trays to prevent microbending losses. Copper cable not in a wireway shall be suspended a minimum of 200 mm above ceilings by cable supports no greater than 1.5 m apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm (12 inches) shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 1.8 meters long shall be neatly coiled not less than 300 mm in diameter below each feed point in raised floor areas.

3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's

recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.3 Telecommunications Outlets

3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 150 mm of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

3.1.6 Fiber Optic Patch Panels

Patch panels shall be mounted in equipment racks with sufficient ports to accommodate the installed cable plant plus 10 percent spares. A slack loop of fiber shall be provided within each panel. Loop shall be 900 mm in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.7 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged rack cabinets shall have adjacent side panels removed. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.

3.1.8 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in ANSI/TIA/EIA-568-B.2-1. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.2.2 Coaxial Cable

Home run type station cables shall be terminated at each CATV box with the specified connector and shall not be terminated at the TV cabinets in the communications rooms. Two (2) meters of slack shall be coiled adjacent to the cabinets in the communication rooms for termination by others. One hundred and fifty (150 mm) of slack shall be left in the cable tray before the transition to the conduit to the CATV outlet box. The vertical cable shall have two (2) meters of slack coiled in the communication rooms for termination by others.

3.2.3 NOT USED

3.2.4 Fiber Optic Cable

Each fiber shall have connectors installed. The pull strength between the connector and the attached fiber shall be not less than 11.3 kg. The mated pair loss, without rotational optimization, shall not exceed 1.0 dB. Fiber optic connectors shall be installed per ANSI/TIA/EIA-568-B.3.

3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with ANSI/TIA/EIA-607 and Section 16415 ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

a. 10 of each type outlet.

b. 10 of each type cover plate.

c. 1 of each type terminal block for each telecommunications closet.

d. 4 Patch cords of 3 m for each telecommunications closet.

e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.5 ADMINISTRATION AND LABELING

3.5.1 Labeling

3.5.1.1 Labels

All labels shall be in accordance with ANSI/TIA/EIA-606.

3.5.1.2 Cable

All cables will be labeled using color labels on both ends with encoded identifiers per ANSI/TIA/EIA-606.

3.5.1.3 Termination Hardware

All workstation outlets and patch panel connections will be labeled using color coded labels with encoded identifiers per ANSI/TIA/EIA-606.

3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

3.6.2 Category 6 Circuits

All category 6 circuits shall be tested using a test set that meets the accuracy requirements of ANSI/TIA/EIA-568-B.2-1. Testing shall use the Basic Link Test procedure of ANSI/TIA/EIA-568-B.2. Cables and connecting hardware which contain failed circuits shall be replaced and retested to verify the standard is met.

3.6.3 Coaxial Cable

Cable shall be tested for continuity, shorts, and opens. Characteristic impedance shall be verified over the range of intended operation. Cable length shall be verified. Cable shall be sweep tested for attenuation over the range of intended operation.

3.6.4 NOT USED

3.6.5 Fiber Optic Cable

Unless stated otherwise, tests shall be performed from both ends of each circuit. Connectors shall be visually inspected for scratches, pits or chips and shall be determined if any of these conditions exist. Each circuit leg and complete circuit shall be tested for insertion loss at 850 and 1300 mm using a light source similar to that used for the intended communications equipment. High-resolution optical time domain reflectometer (OTDR) tests shall be performed from one end of each fiber. Scale of the OTDR trace shall be such that the entire circuit appears over a minimum of 80 percent of the X-axis.

-- End of Section --

SECTION 16711

TELEPHONE SYSTEM, OUTSIDE PLANT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.61	(1993) Gas Tube Surge Arrestors on Wire Line Telephone Circuits

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2239	(1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/TIA/EIA-607	(10/2002) Commercial Building Grounding and Bonding Requirements for Telecommunications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

RURAL UTILITIES SERVICE (RUS)

REA Bulletin 345-50	(1979) Trunk Carrier Systems (PE-60)
REA Bulletin 345-65	(1985) Shield Bonding Connectors (PE-33)
REA Bulletin 1753F-207 (PE-87)	(1994) Terminating Cables
REA Bulletin 1753F-208	(1993) Filled Telephone Cables with Expanded Insulation (PE-89)
RUS Bulletin 1751F-643	(1998) Underground Plant Design

RUS Bulletin 1753F-401(PC-2)	(1995) Splicing Copper and Fiber Optic Cables
RUS REA Bulletin 1751F-641	(1995) Construction of Buried Plant
RUS REA Bull 1753F-201 (PC-4)	(1997) Acceptance Tests and Measurements of Outside Plant
RUS REA Bulletin 1755I-100	(1999) List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers

UNDERWRITERS LABORATORIES (UL)

UL 50	(1995; Rev thru Oct 1997) Enclosures for Electrical Equipment
UL 497	(1995; Rev Mar 1996) Protectors for Paired Conductor Communication Circuits

1.2 SYSTEM DESCRIPTION

The outside plant system shall consist of all cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, terminating cables, lightning and surge protection modules at the entry facility. The work consists of furnishing, installing, testing and making operational a complete outside plant system for continuous use.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telephone System; G, RE
Installation; G, RE

Detail drawings, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, and catalog cuts. Detail drawings shall also contain complete configuration information, wiring diagrams and any other details required to demonstrate that the cable system has been coordinated to support the transmission systems identified in the specifications and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations.

Record Drawings; G, RE

Record drawings for the installed wiring system showing the actual location of all cable terminations, splices, routing, and size and type of all cables. The identifier for each termination and cable shall appear on the drawings. The drawings shall include gauge and pair or fiber count for each cable, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector block layout at the termination points after installation.

SD-03 Product Data

Spare Parts; G, RE
Equipment; G, RE

A data list of recommended spare parts, tools, and test equipment for each different item of material and equipment specified prior to beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Installation; G, RE

Printed copies of the manufacturer's recommendations for the material being installed, prior to installation. Installation of the item will not be allowed to proceed where installation procedures, or any part thereof, are required to be in accordance with those recommendations until the recommendations are received and approved.

Acceptance Tests; G, RE

Test plans defining all tests required to ensure that the system meets specified requirements. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

Cutover and Records; G, RE

The cutover plan shall provide procedures and schedules for relocation of facility station numbers without interrupting service to any active location.

SD-06 Test Reports

Acceptance Tests; G, RE

Test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

SD-07 Certificates

Telephone System; G, RE

Proof that the items furnished under this section conform to the specified requirements in FCC, ICEA, REA, RUS, ANSI, ASTM, NFPA, EIA, or UL, where materials and equipment are so specified.

Qualifications; G, RE

The qualifications of the manufacturer, splicer, and installation supervisor as specified.

1.4 QUALIFICATIONS

1.4.1 Cable Installers

Installation shall be under the direct supervision of an individual with a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.4.2 Cable Splicing and Termination

All cable splicers shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

1.4.3 Manufacturers

The cable, equipment, and hardware provided shall be from manufacturers that have a minimum of 3 years experience in producing the types of cable, equipment, and hardware specified.

1.5 DELIVERY AND STORAGE

1.5.1 Cable Requirements-

All cable shall be shipped on reels. The diameter of the drum shall be large enough to prevent damage to the cable during reeling and unreeling. The reels shall be constructed to prevent damage during shipment and handling. The outer end of the cable shall be securely fastened to the reel head to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel, or into a housing on the inner slot of the drum, with sufficient length to make it available for testing. The inner end shall be fastened to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 to plus 65 degrees C, with relative humidity from 0 to 100 percent.

1.5.2 Equipment

All equipment shall be stored with protection from the weather, humidity

and temperature variations, dirt and dust, or other contaminants, in accordance with the manufacturer's requirements.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 2 years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment. All products supplied shall be specifically designed and manufactured for use with outside plant communications systems. All items of the same class of equipment shall be the products of a single manufacturer.

2.2 CABLE

2.2.1 Copper Conductor Cable

Copper conductor cable shall conform to the following:

2.2.1.1 NOT USED

2.2.1.2 NOT USED

2.2.1.3 Underground

Cable shall be manufactured per REA Bulletin 1753F-208 (PE-89). A 0.2 mm coated aluminum or 0.12 mm copper metallic shield shall be provided. Cable shall be 24 AWG.

2.3 NOT USED

2.4 CABLE SPLICES AND ORGANIZERS

2.4.1 Copper Cable Splices

All cables greater than 25 pairs shall be spliced using modular splicing connectors, which accommodate 25 pairs of conductors at a time. The correct connector size shall be used to accommodate the wire gauge of the cable to be spliced. The connectors used shall be listed in RUS REA Bulletin 1755I-100.

2.5 NOT USED

2.6 MANHOLE AND DUCT

All manhole and duct products shall conform to RUS Bulletin 1751F-643.

2.6.1 NOT USED

2.6.2 NOT USED

2.6.3 Duct/Conduit

Conduit shall be furnished as specified in Sections 16415 ELECTRICAL WORK, INTERIOR and 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on project drawings.

2.6.4 Innerduct

Innerduct shall be SIDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

2.7 EQUIPMENT RACKS

Distribution frames, cabinets, and back-boards shall be provided as shown and designed to mount connector blocks, protector blocks, cross connects, and other hardware required to terminate and protect the outside telephone plant cable; to provide a demarcation point between inside and outside plant cable; and to allow inside and outside plant cable to be cross connected.

2.7.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be double sided aluminum relay racks with uprights to mount equipment 480 mm wide. Uprights shall be 75 mm deep channel, 32 mm wide, drilled and tapped 12-24 in a 13 mm pattern. Racks shall be provided with a standard top cross-member, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 2.1 m in height and painted. AC outlets shall be provided as shown.

2.7.2 Wall Mounted Open Frame

Wall mounted open frame equipment racks shall be aluminum relay racks to mount equipment 480 mm wide with standoff brackets for wall mounting. Uprights shall be drilled and tapped 12-24 in a 13 mm pattern. Standoff brackets shall be of sufficient length for a 150 mm clearance between rack and wall. Wall mounted open frame racks shall be hinged. AC outlets shall be provided as shown.

2.7.3 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 480 mm equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lock-washers.

2.7.4 NOT USED

2.7.5 Wall Mounted Cabinets

Wall mounted cabinets shall conform to UL 50 and have boxes constructed of zinc-coated sheet steel with dimensions not less than shown on drawings. Trim shall be fitted with hinged door and flush catch. Doors shall provide

maximum openings to the box interiors. Boxes shall be provided with 19 mm plywood backboard painted white or a light color. A duplex AC outlet shall be installed within the cabinet.

2.7.6 Equipment Mounting Backboard

Backboards shall be 19 mm AC plywood, sized as shown, painted with white or light colored paint.

2.8 CONNECTOR BLOCKS

Connector blocks consisting of flame-retardant molded plastic fastened to a metal mounting bar shall be provided to terminate the outside plant cable as shown. The connector blocks shall be of 100-pair block size and equipped with protection modules. The connector blocks shall be 24 gauge stub type. The cable stubs shall be 100 pair and conform to REA Bulletin 1753F-207 (PE-87).

2.9 PROTECTOR MODULES

The protector modules shall be of the two-element gas tube type. Protection modules shall be heavy duty, A>10 kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current per ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, be equipped with an external spark gap and heat coils, and shall comply with UL 497.

2.10 NOT USED

2.11 MISCELLANEOUS ITEMS

2.11.1 Shield Connectors

Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire. The connector shall be made of tin-plated tempered brass. Shield bond connectors shall comply with REA Bulletin 345-65.

2.11.2 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. The braid shall be made from flat tin-plated copper.

2.11.3 Warning Tape

Marking and locating tape shall be acid and alkali resistant polyethylene film, 150 mm wide with a minimum strength of 12.1 MPa lengthwise and 10.3 MPa crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 1 m deep. The metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion and shall be specifically manufactured for marking and locating underground utilities. The warning tape shall be orange in color and continuously

imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 1.2 m intervals.

2.11.4 Cable Warning Signs

Cable warning signs, which identify the route of buried cable, shall be stake mounted. The stake shall be driven into undisturbed soil and the sign shall be mounted to the stake in accordance with the manufacturer's instructions. Warning signs shall be placed at intervals of no more than 152.5 m and at each change of direction in the cable route. Warning signs shall also be placed on each side of every crossing of surface obstacles such as roads, railroads, stream crossings, or any similar crossing where excavation is likely to occur.

PART 3 EXECUTION

3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All installation work shall be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and NFPA 70.

3.1.1 Cable Inspection and Repair

All cable and wire used in the construction of the project shall be handled with care. Each reel shall be inspected for cuts, nicks or other damage. All damage shall be repaired to the satisfaction of the Contracting Officer. The reel wrap shall remain intact on the reel until the cable or wire is ready to be placed.

3.1.2 NOT USED

3.1.3 Underground Cable

Underground cable installation shall be accomplished in accordance with the requirements set forth in RUS REA Bulletin 1751F-641.

3.1.3.1 Cable Pulling

For cable installed in ducts and conduit, a cable feeder guide shall be used, between the cable reel and the face of the duct and conduit, to protect the cable and guide it into the duct and conduit as it is paid off the reel. As the cable is paid off the reel, it shall be inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is paid off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-tension instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer.

The mechanical stress placed upon a cable during installation shall not cause the cable to be twisted or stretched.

3.1.3.2 Penetrations for Cable Access

Penetrations in walls, ceilings or other parts of the building, made to provide for cable access, shall be caulked and sealed. Where conduits and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in section 07840 FIRE STOPPING. Fire stopped penetrations shall not compromise the fire rating of the walls or floors. All underground building entries shall be through waterproof facilities.

3.1.3.3 Cable Bends

Telephone cable bends shall have a radius of not less than 10 times the cable diameter. Only large radius sweeps shall be used in conduit runs and shall not exceed a cumulative 90 degrees between manholes.

3.1.4 NOT USED

3.1.5 Manhole and Ducts

Manhole and duct systems shall be installed in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Manholes shall be placed in line with the main duct. Splice cases shall be mounted in the center on the long sides. Lateral conduits shall exit the long sides near the corners.

3.1.5.1 Innerduct Installation

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be plugged at both ends with polyurethane foam duct seal; this material shall also be inserted between the innerduct and the duct if cables are placed in the innerducts. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 50 mm exposed.

3.1.5.2 Pull Cord

Pull cords of 10 mm polypropylene shall be installed in all unused ducts and inner-ducts with a minimum of 610 mm spare cord protruding from each end.

3.1.6 Surge Protection

Except for fiber optic cable, all cables and conductors, which serve as communication lines, shall have surge protection meeting the requirements of REA Bulletin 345-50 installed at the entry facility.

3.2 SPLICING

3.2.1 Copper Conductor Splices

Copper conductor cable splicing shall be accomplished in accordance with RUS Bulletin 1753F-401(PC-2). Modular splicing shall be used on all cables larger than 25 pairs.

3.3 GROUNDING

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals shall be grounded. Grounding shall be in accordance with requirements of NFPA 70, Articles 800-33 and 800-40.

3.3.1 Ground Bars

3.3.1.1 Telecommunications Master Ground Bar (TMGB)

A copper TMGB shall be provided, in accordance with EIA ANSI/TIA/EIA-607, to be the hub of the basic grounding system by providing a common point of connection for ground from outside cable, MDF, and equipment. The TMGB shall have a ground resistance, including ground, of 10 ohms or less.

3.3.1.2 Telecommunications Ground Bar (TGB)

Copper TGB shall be provided in accordance with EIA ANSI/TIA/EIA-607 in each communications closet and room and each frame. The TGB shall be connected to the TMGB in accordance with EIA ANSI/TIA/EIA-607. Each TGB shall be connected to the TMGB by the most direct route utilizing a copper wire conductor with a total resistance of less than 0.01 ohms.

3.3.2 Incoming Outside Plant Cables

All incoming outside plant cable shields shall be bonded directly to the TMGB or the closest TGB.

3.3.3 Cable Stubs

All shields of cable stubs shall be bonded to a TGB located on the frame.

3.3.4 Shields

The shields of all incoming cables shall not be bonded across the splice to the cable stubs.

3.3.5 Protection Assemblies

The protector assemblies shall be mounted directly on the vertical frame ironwork. The assemblies mounted on each vertical frame shall be connected with a No. 6 AWG copper conductor to provide a low resistance path to the TGB.

3.3.6 Manholes

The shields of all cables in each manhole shall be bonded together by a

bonding wire or ribbon. At intermediate manholes, where the cable is pulled through without a sheath opening, bonds are not required. If the manhole has a lacerating bonding ribbon, the shields of spliced cables shall be attached to it.

3.4 CUTOVER AND RECORDS

All necessary transfers and cutovers, shall be accomplished by the Contractor.

3.5 ACCEPTANCE TESTS

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test; testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. The test plans shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

3.5.1 Copper Conductor Cable

The following acceptance tests shall be performed in accordance with RUS REA Bull 1753F-201 (PC-4):

a. Shield continuity.

b. Conductor continuity.

c. Conductor insulation resistance.

d. Structural return loss.

e. Cable insertion loss and loss margin at carrier frequencies.

f. Shield ground for single jacketed cables.

g. DC loop resistance.

-- End of Section --

SECTION 16768

FIBER OPTIC DATA TRANSMISSION SYSTEM - OUTSIDE PLANT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15	Radio Frequency Devices

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 170	(1957) Electrical Performance Standards - Monochrome Television Studio Facilities
EIA ANSI/TIA/EIA-455-13A	(1996) FOTP-13 Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies
EIA ANSI/EIA/TIA-455-25B	(1996) FOTP-25 Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies
EIA ANSI/TIA/EIA-455-41A	(1993) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables
EIA ANSI/EIA/TIA-455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
EIA ANSI/EIA/TIA-455-47B	(1992) FOTP-47 Output Far Field Radiation Pattern Measurement
EIA ANSI/EIA/TIA-455-59	(1989) FOTP-59 Measurement of Fiber Point Defects Using an OTDR
EIA ANSI/EIA/TIA-455-61	(1989) FOTP-61 Measurement of Fiber or Cable Attenuation Using an OTDR
EIA ANSI/EIA-455-81A-91	(1992) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
EIA ANSI/EIA/TIA-455-82B	(1992) FOTP-82 Fluid Penetration Test for

	Fluid-Blocked Fiber Optic Cable
EIA-455-88	(1987) FOTP-88 Fiber Optic Cable Bend Test
EIA ANSI/EIA-455-91	(1986; R 1996) FOTP-91 Fiber Optic Cable Twist-Bend Test
EIA ANSI/TIA/EIA-455-104A	(1993) FOTP-104 Fiber Optic Cable Cyclic Flexing Test
EIA ANSI/EIA/TIA-455-170	(1989) FOTP-170 Cable Cutoff Wavelength of Single-Mode Fiber by Transmitted Power
EIA ANSI/EIA-455-171	(1987) FOTP-171 Attenuation by Substitution Measurement - for Short-Length Multimode Graded-Index and Single-Mode Optical Fiber Cable Assemblies
EIA ANSI/TIA/EIA-455-177A	(1992) FOTP-177 Numerical Aperture Measurement of Graded-Index Optical Fibers
EIA ANSI/TIA/EIA-606	(5/2002) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)	
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA 250	(1991) Enclosures for Electrical Equipment (1000 volts Maximum)
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1999) National Electrical Code
UNDERWRITERS LABORATORIES (UL)	
UL 910	(1998) Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 1666	(1997; R Jan 1999) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fiber Optic System; G, RE
Installation; G, RE

Detail drawings including a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function with its associated systems. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations. System drawings shall show final configuration, including location, type and termination of inside fiber optics and showing the location, duct and innerduct arrangement, or fiber assignment of outside plant. The ac power consumption and heat dissipation shall be shown under both normal and maximum operating conditions.

SD-03 Product Data

Fiber Optic System; G, RE

Equipment calculations for flux budgets and gain margins.

Manufacturer's Instructions; G, RE

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be submitted prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Test Procedures and reports; G, RE

Test plans shall define tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

SD-06 Test Reports

Test Procedures and Reports; G, RE

Test reports, in booklet form showing field tests performed to

adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

SD-07 Certificates

Fiber Optic System; G, RE

Manufacturer's certificate indicating compliance with transmission and reliability requirements. Where equipment or materials are specified to conform to the standards or publications and requirements of CFR, ANSI, NFPA, EIA, or UL, certificates attesting that the items furnished under this section of the specification conform to the specified requirements.

SD-10 Operation and Maintenance Data

System Maintenance Course; G, RE

Six copies of operating instructions outlining the step-by-step procedures required for system operation including description of each subsystem in its operating mode. Instructions shall include the manufacturer's name, service manual, parts list, and a brief description of equipment, components, and their basic operating features. Six copies of the maintenance instructions listing regular maintenance procedures, possible system failures, a troubleshooting guide for repairs, and simplified diagrams for the system as installed. A video describing operating and maintenance instructions may be included.

1.3 SYSTEM DESCRIPTION

1.3.1 General

A fiber optics (FO) data transmission system (DTS) shall be provided. The data transmission system shall consist of fiber optic transmission media, transmitter and receiver modules, FO modems, transceiver modules, repeaters, power line surge protection and terminal devices (such as connectors, patch panels and breakout boxes). The data transmission system shall interconnect system components as shown. Computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class B computing devices and labeled as set forth in 47 CFR 15.

1.3.2 Environmental Requirements

Equipment and cable to be utilized indoors shall be rated for continuous operation under ambient environmental conditions of 0 to 50 degrees C dry bulb and 10 to 95 percent relative humidity, noncondensing. Equipment shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location. Fiber optic cable for outdoor installation shall be rated for Minus 40 to plus 80 degrees C.

1.3.3 Hazardous Environment

System components located in fire or explosion hazard areas shall be rated and installed according to Chapter 5 of NFPA 70 and as shown.

1.3.4 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.3.5 Input Line Surge Protection

Inputs and outputs shall be protected against surges induced on wiring including wiring installed outdoors. Communications equipment shall be protected against surges induced on any communications circuit. Cables and conductors (except fiber optics which serve as communications circuits from consoles to field equipment) and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 1 meter of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.3.6 Power Line Surge Protection

Equipment connected to ac circuits shall be protected from power line surges. Equipment shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

PART 2 PRODUCTS

2.1 NOT USED

2.2 NOT USED

2.3 NOT USED

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 NOT USED

2.9 NOT USED

2.10 NOT USED

2.11 ENCLOSURES

Enclosures shall conform to the requirements of NEMA 250 for the types specified. Finish color shall be the manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish.

2.11.1 Interior

Enclosures installed indoors shall meet the requirements of Type 12 or as shown.

2.12 NOT USED

2.13 NOT USED

2.14 OPTICAL FIBERS

2.14.1 General

Optical fibers shall be coated with a suitable material to preserve the intrinsic strength of the glass. The outside diameter of the glass-cladded fiber shall be nominally 125 microns, and shall be concentric with the fiber core. Optical fibers shall meet EIA ANSI/EIA/TIA-455-46A, and EIA ANSI/TIA/EIA-455-177A.

2.14.2 NOT USED

2.14.3 NOT USED

2.14.4 8.3 Micron Single Mode Fibers

Conductors shall be single-mode, graded index, solid glass waveguides with a nominal core diameter of 8.3 microns. The fiber shall have a transmission window centered at 1550 nanometer wavelength. The numerical aperture for each optical fiber shall be a minimum of 0.10. The attenuation at 1330 nanometers shall be 0.5 dB/Km or less. The fibers shall be certified to meet EIA ANSI/EIA/TIA-455-170.

2.15 CROSS-CONNECTS

2.15.1 Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Patch panel connectors and couplers shall be the same type and configuration as used elsewhere in the system. Panels shall be either a 480 mm rack mount type or wall mounted as shown.

2.15.2 Patch Cords

Patch cords shall be cable assemblies consisting of flexible optical fiber cable with connectors of the same type as used elsewhere in the system. Optical fiber shall be the same type as used elsewhere in the system. Patch cords shall be complete assemblies from manufacturer's standard products.

2.16 CABLE CONSTRUCTION

2.16.1 General

The cable shall contain a minimum of two fiber optic conductors for each full duplex circuit. The number of fibers in each cable shall be as shown. Each fiber shall be protected by a protective tube. Cables shall have a jacketed strength member, and an exterior jacket. Cable and fiber protective covering shall be free from holes, splits, blisters, and other imperfections. The covering shall be flame retardant, moisture resistant, non-nutrient to fungus, ultraviolet light resistant as specified and nontoxic. Mechanical stress present in cable shall not be transmitted to the optical fibers. Strength members shall be non-metallic and shall be an integral part of the cable construction. The combined strength of all the strength members shall be sufficient to support the stress of installation and to protect the cable in service. The exterior cables shall have a minimum storage temperature range of minus 20 to plus 75 degrees C. Interior cables shall have a minimum storage temperature of minus 10 to plus 75 degrees C. All cables furnished shall meet the requirement of NFPA 70. Fire resistant characteristics of cables shall conform to Article 770, Sections 49, 50, and 51. A flooding compound shall be applied into the interior of the fiber tubes, into the interstitial spaces between the tubes, to the core covering, and between the core covering and jacket of all cable to be installed aerially, underground, and in locations susceptible to moisture. Flooded cables shall comply with EIA ANSI/EIA-455-81A-91 and EIA ANSI/EIA/TIA-455-82B. Cables shall be from the same manufacturer, of the same cable type, and of the same size. Each fiber and protective coverings shall be continuous with no factory splices. Fiber optic cable assemblies, including jacketing and fibers, shall be certified by the manufacturer to have a minimum life of 30 years. Plenum cable shall meet UL 910, and riser cable shall meet UL 1666. FO cable shall be certified to meet the following: EIA ANSI/TIA/EIA-455-13A, EIA ANSI/EIA/TIA-455-25B, EIA ANSI/TIA/EIA-455-41A, EIA ANSI/EIA/TIA-455-47B, EIA ANSI/EIA/TIA-455-59, EIA ANSI/EIA/TIA-455-61, EIA-455-88, EIA ANSI/EIA-455-91, EIA ANSI/TIA/EIA-455-104A, and EIA ANSI/EIA-455-171.

2.16.2 Exterior Cable

2.16.2.1 NOT USED

2.16.2.2 Duct Cable

The optical fibers shall be surrounded by a tube buffer, shall be contained in a channel or otherwise loosely packaged to provide clearance between the fibers and inside of the container, and shall be extruded from a material

having a coefficient of friction sufficiently low to allow the fiber free movement.

a. The cable outer jacket shall be medium density polyethylene material with orange pigment added for ease of identification.

b. Tensile strength: Cables shall withstand an installation tensile load of not less than 2700 Newtons and not less than 600 Newtons continuous tensile load.

c. Impact and Crush resistance: The cables shall withstand an impact of 3 Newton-meters as a minimum, and shall have a crush resistance of 220 Newtons per square centimeter as a minimum.

2.17 FO CONNECTORS

FO connectors shall be the straight tip, bayonet style, field installable, self-aligning and centering. FO connectors shall match the fiber core and cladding diameters. The connector coupler shall be stainless steel and the alignment ferrule shall be ceramic. FO equipment and cable shall use the same type connectors. Connector insertion loss shall be nominally 0.3 dB and less than 0.7 dB.

2.18 MECHANICAL SPLICES

Mechanical splices shall be suitable for installation in the field. External power sources shall not be required to complete a splice. Splices shall be self-aligning for optimum signal coupling. Mechanical splices shall not be used for exterior applications where they may be buried underground or laced to aerial messenger cables. Mechanical splices may be used for interior locations and within enclosures. Splice closures shall protect the spliced fibers from moisture and shall prevent physical damage.

The splice closure shall provide strain relief for the cable and the fibers at the splice points.

2.19 CONDUIT, FITTINGS AND ENCLOSURES

Conduit shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR, and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, and as shown.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. Interconnections, services, and adjustments required for a complete and operable data transmission system shall be provided.

3.1.1 Interior Work

Conduits, tubing and cable trays for interior FO cable interior shall be installed as specified in Section 16415 ELECTRICAL WORK, INTERIOR and as

shown. Cable installation and applications shall meet the requirements of NFPA 70, Article 770, Sections 52 and 53. Cables not installed in conduits or wireways shall be properly secured and neat in appearance, and if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.2 NOT USED

3.1.3 Exterior Underground Cable

Except as otherwise specified, conduits, ducts, and manholes for underground FO cable systems shall be installed as specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown.

a. Minimum burial depth for cable shall be 750 millimeters, but not less than the depth of the frost line. Burial depth specified shall take precedence over any requirements specified elsewhere.

b. Buried cable ducts shall be placed below a plastic warning tape buried in the same trench or slot. The tape shall be 300 millimeters above the cable. The warning tape shall be continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 1300 millimeters intervals. The plastic tape shall be acid and alkali resistant polyethylene film, 76.2 millimeters wide with a minimum thickness of 0.1 millimeter. Tape shall have a minimum strength of 12066 kilo Pascals lengthwise and 10342 kilo Pascals crosswise.

c. For cables installed in ducts and conduit, a cable lubricant compatible with the cable sheathing material shall be used on all cables pulled. Pulling fixtures shall be attached to the cable strength members. If indirect attachments are used, the grip diameter and length shall be matched to the cable diameter and characteristics. If an indirect attachment is used on cables having only central strength members, the pulling forces shall be reduced to ensure that the fibers are not damaged from forces being transmitted to the strength member. During pulling the cable pull line tension shall be continuously monitored using dynamometers or load-cell instruments, and shall not exceed the maximum tension specified by the cable manufacturer. The mechanical stress placed upon the cable during installation shall be such that the cable is not twisted or stretched. A cable feeder guide shall be used between the cable reel and the face of the duct or conduit to protect the cable and guide it into the duct or conduit as it is unspooled from the reel. As the cable is unspooled from the reel, it shall be inspected for jacket defects or damage. The cable shall not be kinked or crushed and the minimum bend radius of the cable shall not be exceeded during installation. Cable shall be hand fed and guided through each manhole and additional lubricant shall be applied at all intermediate manholes. When practicable, the center pulling technique shall be used to lower pulling tension. That is, the cable shall be pulled from the center point of the cable run towards the end termination points. The method may require the

cable to be pulled in successive pulls. If the cable is pulled out of a junction box or manhole the cable shall be protected from dirt and moisture by laying the cable on a ground covering.

3.1.4 Service Loops

Each fiber optic cable shall have service loops of not less than 3 meters in length at each end. The service loops shall be housed in a service loop enclosure.

3.1.5 NOT USED

3.1.6 Splices

No splices will be permitted unless the length of cable being installed exceeds the maximum standard cable length available from a manufacturer or unless fiber optic pigtails are used to connect transmitters, receivers, or other system components for terminations to the fiber. Splices shall be made using the method recommended by the cable manufacturer. Splices shall be housed in a splice enclosure and shall be encapsulated with an epoxy, ultraviolet light cured splice encapsulant or otherwise protected against infiltration of moisture or contaminants. FO splices shall be field tested at the time of splicing. Fusion splices shall have less than 0.2 dB loss.

Mechanical splices shall have less than 0.5 dB loss. There shall be no more than 1 splice per kilometer in any of the FO cables excluding terminations. Field splices shall be located in cable boxes. Sufficient cable shall be provided in each splicing location to properly rack and splice the cables, and to provide extra cable for additional splices. Cable ends shall be protected with end caps except during actual splicing. During the splicing operations, means shall be provided to protect the unspliced portions of the cable and its fibers from the intrusion of moisture and other foreign matter.

3.1.7 Connectors

Connectors shall be as specified in paragraph FO CONNECTORS. Fibers at each end of the cable shall have jumpers or pigtails installed of not less than 1 meter in length. Fibers at both ends of the cable shall have connectors installed on the jumpers. The mated pair loss, without rotational optimization, shall not exceed 1.5 dB. The pull strength between the connector and the attached fiber shall not be less than 22.7 kilograms.

3.1.8 Identification and Labeling

Identification tags or labels shall be provided for each cable. Markers, tags and labels shall use indelible ink or etching which will not fade in sunlight, or in buried or underground applications. Markers, tags, and labels shall not become brittle or deteriorate for a period of 20 years. Label all termination blocks and panels with cable number or pair identifier for cables in accordance with EIA ANSI/TIA/EIA-606 and as specified. The labeling format shall be identified and a complete record shall be provided to the Government with the final documentation. Each

cable shall be identified with type of signal being carried and termination points.

3.1.9 Enclosure Sizing and Cable

Termination enclosures shall be sized to accommodate the FO equipment to be installed. Sizing shall include sufficient space for service loops to be provided and to accommodate a neat, workmanlike layout of equipment and the bend radii of fibers and cables terminated inside the enclosure.

3.1.10 Enclosure Penetrations

Enclosure penetrations shall be from the bottom and shall be sealed with rubber silicone sealant to preclude the entry of water. Conduits rising from underground shall be internally sealed.

3.1.11 Conduit-Enclosure Connections

Conduit-enclosure connections shall be protected by tack welding or brazing the conduit to the enclosure. Tack welding or brazing shall be done in addition to standard conduit-enclosure connection methods as described in NFPA 70. Any damage to the enclosure or its cover's surface protection shall be cleaned and repaired using the same type of surface protection as the original enclosure.

3.2 TESTING

3.2.1 General

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform testing.

3.2.2 Contractor's Field Test

The Contractor shall verify the complete operation of the data transmission system in conjunction with field testing associated with systems supported by the fiber optic data transmission system prior to formal acceptance testing. Field tests shall include a flux density test. These tests shall be performed on each link and repeated from the opposite end of each link.

3.2.2.1 Optical Time Domain Reflectometer Tests

Optical time domain reflectometer tests shall be performed using the FO test procedures of EIA ANSI/EIA/TIA-455-59. An optical time domain reflectometer test shall be performed on all fibers of the FO cable on the reel prior to installation. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. Photographs of the traces shall be furnished to the Government. An optical time domain reflectometer test shall be performed on all fibers of the FO cable after it is installed. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. If the optical time domain reflectometer test results show anomalies greater than 1 dB, the FO cable segment is unacceptable to the Government. The unsatisfactory segments of cable shall be replaced with a new segment of cable. The new segment of

cable shall then be tested to demonstrate acceptability. Photographs of the traces shall be furnished to the Government for each link.

3.2.2.2 Power Attenuation Test

Power attenuation test shall be performed at the light wavelength of the transmitter to be used on the circuit being tested. The flux shall be measured at the FO receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. If the circuit loss exceeds the calculated circuit loss by more than 2 dB, the circuit is unsatisfactory and shall be examined to determine the problem. The Government shall be notified of the problem and what procedures the Contractor proposes to eliminate the problem. The Contractor shall prepare and submit a report documenting the results of the test.

3.2.2.3 Gain Margin Test

The Contractor shall test and verify that each circuit has a gain margin which exceeds the circuit loss by at least 6 dB.

3.2.2.4 Analog Video

Test Analog circuits shall be tested using a signal conforming to EIA 170. The monitor or automated test set shall be stable, and shall be as described in EIA 170. If the result is unsatisfactory, the circuit shall be examined to determine the problem. The Government shall be notified of the problem and of the procedures the Contractor proposes to eliminate the problem. The Contractor shall prepare and submit a report documenting the results of the test.

3.3 TRAINING

3.3.1 General

The Contractor shall conduct a training course for designated personnel in the maintenance of the FO system. The training shall be oriented to the specific system being installed under this specification. The Contractor shall furnish training materials and supplies.

-- End of Section --