AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES	
J	1	2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO.(If applicable)
0004	07-Feb-2003	W22W9K-2317-5658	

6. ISSUED BY CODE DACA27

USA ENGINEER DISTRICT, LOUISVILLE
ATTN: CELRL-CT
600 DR. MARTIN LUTHER KING PLACE
ROOM 821
LOUISVILLE KY 40202

7. ADMINISTERED BY (If other than item 6) CODE DACA27

CONTRACT ADMINSTRATION BRANCH
ATTN: JENNIFER J. ANDERSON
P. O. BOX 59
LOUISVILLE KY 40201-0059

8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)

CODE FACILITY CODE

X	9A. AMENDMENT OF SOLICITATION NO. DACA27-03-R-0005
X	9B. DATED (SEE ITEM 11) 20-Dec-2002
	10A. MOD. OF CONTRACT/ORDER NO.
	10B. DATED (SEE ITEM 13)

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer [ ] is extended, [X] is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

[ ] A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

[ ] B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).

[ ] C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

[ ] D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Solicitation DACA27-03-R-0005, Fully Contained Small Arms Range Complex, WPAFB, OH is hereby amended as follows:

a. Delete specification sections 01321 and 15900.
b. Add new attached sections 01331, 15951 and 15995.
c. Replace section 01010 and 01020 with the revised attached sections 01010 and 01020 (Amendment 0004).
d. Replace wage rates with the attached revised OH020029 dated 31 January 2003, and are hereby incorporated into this solicitation.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) TEL: EMAIL:	
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY (Signature of Contracting Officer)	16C. DATE SIGNED 07-Feb-2003

e. Amendment 0002, Item 14.d., page 9 of 177 ("The proposal due date remains February 5, 2003, 2:00 p.m., local time") is **deleted in it's entirety.**
f. **The proposal due date remains February 18, 2003, 2:00 pm, local time.**
g. THIS AMENDMENT MUST BE ACKNOWLEDGED.

(End of Summary of Changes)

SECTION C-01010

PROJECT SYNOPSIS

PART 1 - GENERAL

1.1 Provide all labor, equipment, supplies, consultant services and materials to design and construct a new Fully Contained Small Arms Range Complex for the training of military personnel. The project will include facilities for certification in the use of handguns with a maximum caliber of 45, shotguns that utilize 12 gauge slugs, rifles and machine guns with a maximum caliber of 7.62mm. The range will include 21 firing line positions for pistols, rifles and shotguns and two safety lanes. In addition, two special firing line positions and two safety lanes for machine guns is required. Range support functions include a bullet trap area, weapons maintenance / cleaning room, classrooms, administrative offices, target storage & repair, storage of range supplies / equipment and an alarmed arms vault. The project also includes demolition of existing utilities and removal of an existing building slab on the new construction site. Provide a complete and usable facility, including all site requirements and site restoration to meet the requirements contained herein. The Contractor will be required to prepare original drawings using a CADD System (as defined in Section 01021) and shall supply a record of the as-built drawings on magnetic media in Microstation format to the Government at the completion of the project.

Base Bid – This project will consist of a Base Bid and Options. All design and construction for this RFP is included as part of the Base Bid, except for the Bid Options identified as follows:

Option #1 – Furniture (See 01020, 4.2 and 4.3)

1.2 RFP DOCUMENTS

1.2.1 These RFP documents set forth the parameters for the development of a full and complete design.

1.2.2 These RFP documents are provided as a performance standard. The Contractor is required to independently prepare and submit for approval a complete Design. The Contractor’s Design Professionals shall independently confirm and be responsible for the technical accuracy and adequacy of all aspects of the design.

1.2.3 Where conflicts or question arise regarding the application of the requirements outlined in the RFP documents, the following order of precedence shall apply:

1. RFP specification section 01020
2. RFP specification section, 01021
3. RFP specification section 01010
4. RFP Drawings

5. UFGS Technical Specifications
6. WPAFB Base Facility Standard

1.2.4 The RFP documents are intended to define the functional and aesthetic project Design/Build requirements. The contractor is responsible for the design and coordination necessary to provide a complete and useable facility in accordance with the RFP requirements. The RFP documents are not intended to be construction documents. It is expected that the contractor will investigate the RFP requirements and independently further develop the design to sufficiently prepare a proposal. The Contractor shall involve their subcontractors (including their designer) in the preparation of the proposal.

1.3 PROPOSAL REQUIREMENTS

1.3.1 Respondents to this Request for Proposal (RFP) must provide sufficient data and detail in their proposal, as indicated in Section 00115 of this solicitation.

1.4 UTILITIES

1.4.1 Unless noted otherwise in this solicitation, respondents shall assume that adequate utility capacities for power, communications, water, steam, sanitary sewer, and storm sewer are available at the site to support the facility. Upgrading the existing utilities (unless noted otherwise) outside the limits of construction is not a part of this project.

1.5 CODES AND STANDARDS

1.5.1 Comply with the applicable current state, local and National Codes & Standards, requirements of product manufacturers, authorities having jurisdiction and requirements of these RFP documents in the preparation of the project final design and construction. The current edition of the Codes and Standards applicable to this project include, but are not limited to (where there are discrepancies between codes the most stringent requirement shall apply):

- Wright-Patterson Base Facility Standard, Edited Edition Attached
- U.S. and Ohio Environmental Protection Agency applicable standards and codes
- International Building Code (IBC) 2000
- NFPA 24
- NFPA 72
- NFPA 101, Life Safety Code
- NFPA 10, 13, 17, 90A, 90B, 96
- ASHRAE Fundamentals Handbook
- ASHRAE Standard 62-1989
- National Standard Plumbing Code
- International Mechanical Code
- National Electrical Code
- Occupational Safety and Health Act (OSHA) - applicable standards and regulations of the latest edition
- Asphalt Institute Standards

- American Concrete Institute (ACI)
- Architectural Woodwork Institute (AWI)
- American National Standards Institute (ANSI)
- American Welding Society (AWS) “Structural Welding Code”
- American Water Works Association (AWWA)
- American Society for Testing and Materials (ASTM)
- ASCE 7-98, Minimum Design Loads for Buildings and Other Structures
- NFPA 75
- NFPA 24

1.6 SPECIFICATIONS

1.6.1 The RFP is intended to provide minimum standards for quality of materials and construction. The RFP shall be used by the Design/Build Contractor as the basis for development of a comprehensive specification

1.6.2 The guide specifications have been included to ensure a level of quality expected in Military Construction and, in many cases, exceed what is required for a merely functional project. The Government has included these requirements for a number of reasons, including better efficiency, longer life, less maintenance, etc. Guide specification paragraphs describing materials and equipment that are to be used on this project, as well as the associated installation, execution, and general requirement paragraphs, shall be retained verbatim in the final specifications. Paragraph numbering shall not be altered. Inapplicable paragraphs shall be replaced with the words "Not Used" while retaining the paragraph number.

1.6.2 The Design/Build Contractor shall provide typed edited copy of specifications for the design using Specintact format.

1.7 USE OF THE PROJECT SITE

1.7.1 Contractor shall have use of the project site for execution of the work as defined in the requirements of *Construction Considerations and Use of Premises* outlined in Section 01020. Entrance into and interface with the surrounding facilities shall be coordinated in advance with the Contracting Officer. The project site is “secured” within the fenced boundaries of the Base. Access will require advance notice and security passes at all times.

1.8 SAFEKEEPING OF PRODUCTS AND MATERIALS

1.8.1 Contractor shall assume full responsibility for protection and safekeeping of products and materials stored on the site under this Contract.

1.9 AS-BUILT DRAWINGS

1.9.1 Contractor shall provide as-built drawings (electronic file) to the Contracting Officer. Refer to Specification *Section 01021, Design Submission Requirements After Award* and section 00800 for specific requirements.

1.10 PERMITS

1.10.1 General Information:

1.10.1.1 Contractor is required to investigate, submit for any permits necessary for the design and construction of this facility. All permit applications shall be submitted to the Contracting Officer Representative; refer to Section 01020 for environmental permitting requirements (Contractor will pay all permit fees):

1.10.1.2 New steam, water, sanitary sewer, and electrical service will be extended to the new building site from local adjacent utilities. Existing utilities at the demolition site will be removed and / or capped below grade.

1.10.1.3 The following permitting requirements are anticipated:

1.10.2 Storm Water Permit Requirements:

***4**

1.10.2.1 An NPDES Permit will be required. The contractor shall pay all fees associated with the permit or Notice of Intent and shall prepare documents as required to obtain the permit. A check for the appropriate amount shall accompany the draft NOI package described below. *4

***4**

1.10.2.2 Because this project will disturb more than one (1) acre of land (requirement is effective 10 March 2003), a National Pollution Discharge Elimination System Notice of Intent (NOI) will be required to be issued by the Ohio EPA. The Design / Build Contractor shall prepare the following documents prior to **ground disturbing activities**. ***4**

***4**

a. Prepare a Stormwater Pollution Prevention Plan (2 copies – 1 to be maintained on site, **1 to the Contracting Officer**). Refer to the Ohio EPA web site for information http://www.epa.state.oh/us/dsw). ***4**

***4**

b. Prepare a Notice of Intent (NOI) a minimum of 60 days prior to the commencement of construction, consisting of:

***4**

- NOI Application Form
- NOI Application Instructions
- SWPP
- 8-1/2″ x 11″ drawing of excavation area, including adjacent areas (4 copies)
- NOI fees in accordance with the Ohio EPA schedule for sites greater than 1acre.

***4**

Submit **the** documents to the Contracting Officer for coordination with the Wright-Patterson Base Environmental office for review and submission to the Ohio EPA. **Delays resulting from inadequate documents shall be the contractor's responsibility.** ***4**

1.10.2.3 The Design / Build Contractor shall prepare a Notice of Termination (NOT) thirty (30) days after completion of the project. Prepare and submit the following:

a. NOT Application Form notifying the Ohio EPA of termination of activity

b. NOT Application Instructions

Submit documents to the Contracting Officer for coordination with the Wright-Patterson Base Environmental office for review and submission to the Ohio EPA.

1.10.3 Water Main Permit Requirements:

1.10.3.1 An Ohio EPA Plans Approval is required for the extension of water main service to the building. The Design / Build Contractor shall prepare and submit the following:

a. Plans and profiles of the new water main, including adjacent and intersecting utilities, design details and construction specifications.

b. A completed Ohio EPA "Water Supply Data Sheet" and "Fee Worksheet". Copies of these forms are available from the Ohio EPA.

c. Application fee is calculated at 0.20% of the water main construction cost plus $100.00.

1.10.4 Natural Gas Main Permit Requirements:

1.10.4.1 None required.

1.10.5 Air Permits:

1.10.5.1 An Air Permit may be required for the Range Exhaust system. Contractor shall investigate the permit requirement during the design process. If a permit is required, the Contractor shall prepare all permit application documents and submit to the Contracting Office for coordination through the WPAFB Base Environmental Office.

1.11 SHOP DRAWING REVIEW AND APPROVAL

1.11.1 Contractor's "Designer of Record" shall be required to review and approve all shop drawings that are required by the design.

1.11.2 Submittals for the above shop drawings shall be in accordance with Section 01331. Government may review these submittals for compliance with the contract.

PART 2 - DESCRIPTION OF RFP PROCESS

2.1 GENERAL

2.1.1 This project will be designed and constructed by a single firm or team of firms (the Contractor), that has registered architects and engineers employed by or subcontracted to their organization. The Contractor is responsible for the design and construction whether the Contractor uses architects and engineers from within his organization or subcontracts with an outside Architect/Engineer firms(s) for design services.

2.1.2 An outline description of the Design-Build (DB) process follows:

2.2 PROPOSAL PHASE

2.2.1 The Proposal Phase includes that time from announcement of the project through the selection process and the final award of the contract to the successful Offeror.

2.2.2 To be considered for selection, respondent must submit all required documents as specified in Section 00115.

2.2.3 The Corps of Engineers will evaluate the proposals and will award the contract to a single Offeror based upon criteria, which is outlined in Section 00130 (Evaluation Factors and Award). The Government may accept any alternates as determined to be in its best interest.

2.3 DESIGN & CONSTRUCTION PHASE

2.3.1 Refer to specification Section 01021 for information regarding the requirements during design and construction.

PART 3 - PROJECT SCHEDULE

3.1 GENERAL

3.1.1 The Contractor shall complete the entire work ready for use as stated in Section 00800, paragraph 1.3.

3.1.2 Refer to Sections 00115 and 00130 for the schedule to be submitted with the proposal.

3.1.3 The schedule must allow 21 days after receipt for Government review of each design submittal. If the submittal arrives on Friday or a weekend, the review time starts on the following Monday. Sufficient time should be included in the schedule for mailing, a review meeting at Wright-Patterson AFB, correction of the documents by the contractor and backcheck of the corrections by the Government and the contractor together, at each design submittal.

3.1.4 The contractor must ensure that all elements of his team concur in the design and in responses to comments before being submitted to the Government for review. Delays because sub-contractors do not agree with the design or comment responses will be the Contractor’s responsibility.

***1**

3.2 SUMMARY LIST OF MAJOR MILESTONE EVENTS DURING DESIGN & CONSTRUCTION

1. **Contract Award / Design Notice to Proceed (NTP).**
2. **Submit Design Quality Control Plan.**
3. **Submit required state construction and NPDES permits**
4. **Predesign/build Meeting and Voluntary Partnering Workshop.**
5. **Submit Phase I Design.**
6. **Receive Government Review Comments.**
7. **Conduct Review Meeting.**
8. **Distribute comments, responses and meeting minutes.**
9. **Make design corrections/revisions to design.**
10. **Phase I Construction NTP**
11. **Submit Phase II Uncorrected Final Design.**
12. **Receive Government Review Comments.**
13. **Conduct Review Meeting.**
14. **Distribute comments, responses and meeting minutes.**
15. **Make design corrections/revisions to design.**
16. **Phase II 100% Design Backcheck.**
17. **Submit Phase II Certified 100% Design.**
18. **Phase II Construction NTP (5 days after Phase II Certified 100% Design submitted).**
19. **Project Substantial Completion.**

Project Schedule as shown above represents the government's estimate of time required to complete the project. *1

-- End of Section --

SECTION 01020

GENERAL DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS:

1.1.1 The project will include facilities for a new 2,653SM Fully Contained Small Arms Range for certification in the use of handguns, shotguns, rifles and machine guns. The range will include 21 firing line positions for pistols, rifles and shotguns and two special firing line positions for machine guns and safety lanes. Range support functions include a bullet trap area, weapons maintenance / cleaning room, classrooms, administrative offices, target storage & repair, storage of range supplies / equipment and an alarmed arms vault. The project also includes demolition of existing utilities and removal of an existing building slab on the new construction site.

1.1.2 All aspects of this project, including but not limited to, the RFP requirements, demolition of facilities, extension, interface, and connection of all required utilities, and all necessary site demolition and development shall be included in this Design/Build contract.

1.1.3 Site Plans, Building Plans, Elevations and specifications are provided as guidance in outlining the project development requirements. The Contractor will be fully responsible for preparing independently developed 100% complete design documents.

***1**
The Contractor shall incorporate the following into the design and construction:

A. Add operable awning windows to (2) locations for a total of (4) windows in Room 109 (Classroom). Windows shall be as detailed in project drawings and similar to requirements for Room 106 (Office). Window locations shall be coordinated with exterior wall panels.

B. Relocate elevated instructional platform in Room 109 (Classroom) from East wall to West wall. Relocate all electrical and communication requirements as required.

***1**

1.1.4 All items listed in Section *01020 - GENERAL DESIGN REQUIREMENTS* are included to define the scope of the complete design and construction requirements for this contract. The Contractor is responsible to develop a complete design, sufficient to fulfill the requirements of this RFP. Refer to SECTION 01021, DESIGN SUBMISSION REQUIREMENTS AFTER AWARD for design submittal requirements.

1.1.5 Drawings included in this RFP are provided as general guidance for design, construction and quality. It shall be the Design/Build Contractor’s responsibility to verify the accuracy of the documents provided.

1.1.6 Any trade names identified are used to indicate a level of quality and/or compatibility required.

1.1.7 Affirmative Procurement is defined as the process of purchasing environmentally preferable products, especially products manufactured from

recycled and reclaimed materials. The United States Environmental Protection Agency (USEPA) has designated 54 guideline items in the Comprehensive Procurement Guideline (CPG) III for mandatory procurement. These CPG products are products that are or can be made containing recycled materials. A current detailed listing of these products and recycled content requirements can be found on USEPA's web site at http://www.epa.gov/cpg/products.htm In the CPG, the USEPA organizes these items into 8 product categories as follows:

1. Construction Products
2. Landscaping Products
3. Non-paper Office Products
4. Paper and Paper Products
5. Park and Recreation Products
6. Transportation Products
7. Vehicular Products
8. Miscellaneous Products

1.1.7.1 The Design/Build Contractor is required to research, propose, and utilize these designated products, and any other recycled-content products available in the market place. CPG products with the highest percentage of recovered materials practicable shall be utilized, unless otherwise specified, or if one or more of the following exemptions apply:

1. Does not meet appropriate performance specifications.
2. Is not available competitively (from two or more sources).
3. Is not available within a reasonable time frame.
4. Is only available at an unreasonable price.

1.1.7.2 The contractor shall certify that the percentage of recovered materials to be used in the performance of the contract will be at least the amount required by applicable specifications or other contractual requirements, and shall also estimate the percentage of total material utilized for the performance of the contract which is recovered material. If CPG products are not utilized, the contractor shall provide written explanation and documentation as to why the products were not used.

PART 2 - SITE REQUIREMENTS

2.1 EXISTING SITE CONDITIONS

2.1.1 The project site is located in Area A, bound by Skeel Avenue on the south, Communications Boulevard on the east, Newark Street on the north and Building 879 on the west. The site is relatively flat and has an old building slab and footings remaining. Existing asphalt and concrete paving surrounds most of the area around the existing building slab. Base Civil Engineering currently uses the site as an outside storage area.

2.1.2 Contractor shall remove the existing concrete building slab, footings, foundations, concrete and asphalt paving, and any other existing structures

within the project site. The Contractor shall remove the existing entrance pavement to the construction site from Newark Street as shown on the plan.

2.1.3 A topographic survey has been performed. The site has approximately one meter of total relief across the site. The survey information is shown on the existing site plan. Existing utility locations are plotted on the existing site based on field observations or from existing utility plans. Contractor shall confirm all utility locations prior to beginning any work on the site.

2.1.4 A preliminary geotechnical analysis has been performed. A summary of preliminary findings indicates the following:

a. The new building site includes asphaltic concrete and concrete (from existing roadways) Asphaltic concrete is 2″thick +/- with a 6″ +/- granular base. Concrete is 6″+/- thick with a 3″ +/- granular base.
b. The new building site includes an existing building foundation and floor slab. Floor slab is 6-1/2″ +/- thick with a 6″ granular base.
c. Existing Fill soils were encountered at the south end of the new building site. Fill should be considered uncontrolled and not suitable for direct foundation support. Remove any uncontrolled fill and replace with structural fill.
d. Column and wall foundations bearing within the natural undisturbed soils or upper medium dense granular outwash soils can be designed for net allowable bearing capacities of 4,000 and 3,000 psf respectively.
e. Boring logs are provided at the end of this specification section. Contractor shall use the boring log data to establish the appropriate depth of excavation to reach suitable undisturbed soils for the foundation and building floor slab. Contractor shall provide structural fill as required to establish final grades for construction. The boring logs are not intended to replace the Contractor’s responsibility to perform an independent geotechnical analysis as required herein.

The D/B Contractor is responsible to confirm the information provided and do any additional investigation or analysis to confirm the existing soil conditions and provide appropriate recommendations for the building design. The Contractor shall conduct an independent geotechnical analysis and will be completely responsible for the building foundation design.

2.2 SITE PREPARATION

2.2.1 All existing paving, building slabs, building footings, paving materials, drainage structures and piping, vegetation, debris, and surface soils containing organic materials shall be removed from the construction area and removed from the site. Suitable topsoil shall be stockpiled for use in final grading. During stripping and rough grading, positive surface drainage shall be maintained to prevent the accumulation of water.

2.2.2 The exposed sub grade in the building and pavement areas shall be proof rolled to detect unsuitable near-surface soil conditions. Proof rolling shall be done after a suitable period of dry weather to avoid degrading an otherwise acceptable sub grade. Proof rolling shall be done with a heavily loaded tandem dump truck or similar approved construction equipment. Soft, organic, plastic, or excessively wet soils shall be excavated and replaced with compacted backfill. Contractor shall have his Geotechnical Engineer inspect the subgrade and observe / supervise proof rolling operations.

2.2.3 Sediment and erosion control measures shall be required to be installed and maintained by the contractor for the duration of the construction.

2.2.4 Repair existing surrounding pavement and site that is disturbed or damaged during the project construction.

2.2.5 Provide any required additional fill or topsoil necessary to establish the required finish grades.

2.2.6 The existing overhead steam line from building 10867 to 10879 shall be removed. For bidding purposes, the Contractor shall assume the steam line is insulated with Asbestos Containing Material (ACM). Test insulation for ACM. If it is determined to be ACM, remove and dispose of per the requirements of section 02085.

2.3 GRADING

2.3.1 Before any required filling operations begins, representative samples of the proposed fill material shall be tested to determine the maximum dry density, optimum moisture content, natural moisture content, gradation, and plasticity of the soil for quality control during grading compaction operations.

2.3.2 All compacted fill should be constructed by spreading satisfactory material in loose layers not more than 200 mm thick and compacting per the specifications and the geotechnical report.

2.4 SITE ASPHALT PAVING & CONCRETE CURBS

2.4.1 The extent of paving shall be as indicated on the drawings. A new asphalt drive, asphalt parking area, and concrete curbs shall be provided to maintain proper drainage and service the new building.

2.4.2 All materials for the paving shall be in accordance with the latest edition of the Ohio Department of Transportation Construction and Materials Specifications or in accordance with the specifications herein whichever is more stringent.

2.4.3 All paving methods and paving equipment shall be in accordance with the latest edition of the Ohio Department of Transportation Construction and Materials Specifications.

2.4.4 All paving shall be performed to drawing detail "heavy duty" paving section to permit access by delivery and maintenance vehicles at the front and rear of the building.

2.5 STORM DRAINAGE

2.5.1 Surface drainage for the site shall be modified as shown on the plans. Existing storm water flows to the north and to the west from this site into two separate storm sewerage systems. Modifications will affect structures associated with both existing storm drainage systems. Existing storm drainage to the east will not be affected by project.

2.5.2 Design and sizing of storm sewer system shall be based upon the Rational Method using a 25-year storm frequency. Sizing of pipes and structures will not need to include upstream flows. The minimum size of storm sewers shall be 300 mm in diameter.

2.5.3 Existing storm drainage structures and associated piping shall be removed to the limits indicated on the plans. Contractor shall backfill the excavated

areas with satisfactory fill material in layers not exceeding 200 mm thick and compact per the specifications and referenced geotechnical report.

2.5.4 Contractor shall adjust existing storm drainage structures to grade as indicated on the plans.

***4**
2.5.5 **Storm Water Sewer**:

a. Contractor shall **prepare** application for all appropriate EPA plan approvals as required for the proposed modifications to the existing storm water systems **and submit them to the Contracting Officer.**
b. Contractor shall submit five (5) copies of the following information to 88 ABW/EMY:
   I. Plans and profiles of the proposed storm water modifications locations of adjacent and intersecting utilities, design utilities, design details, and construction specifications.
   II. Completed EPA forms and appropriate fees.
   III. Application fees

The 88 ABW/EMY will submit the documents to the EPA after receipt from the **Contracting Officer**. It normally takes four weeks for approval from the EPA.

***4**

2.6 SANITARY SEWER

2.6.1 Sanitary sewer for the new construction will be provided by connection to an existing manhole on the site as indicated on the plans.

***4**
2.6.2 Approval is required for the sewer tap-in to the existing sanitary sewer system. Contractor shall submit all necessary forms, plans, specifications, and fees to **the Contracting Officer**. Questions should be directed to Jerry Merryman at 88 ABW/EMY (937-257-5536).

***4**

2.6.3 Contractor shall verify that the existing sewer main on the site is serviceable. Contractor shall flush the main to remove any debris or blockages.

2.7 WATER DISTRIBUTION

2.7.1 Water for the new construction will be supplied by an 8-inch water main as indicated on the plans. The new main will be connected to an existing 10” CIP water main that lies on the east side of Newark Street. Contractor shall coordinate in advance the tap into the existing main with the Contracting Officer.

***4**
2.7.2 An Ohio EPA plan approval is required for the extension of the water main. Contractor shall submit five (5) copies of the following information to **the Contracting Officer.**

a. Plans and profiles of the new water main including locations of adjacent and intersecting utilities, design utilities, design details, and construction specifications.
b. A completed Ohio EPA “Water Supply Data Sheet” and: Fee Worksheet”
c. Application fee, calculated at 0.20% of the water main construction cost plus $100.00.

***4**

***4**
2.7.3 The 88 ABW/EMY will submit the documents to the Ohio EPA after receipt from the **Contracting Officer**. It normally takes three to four months for approval from the Ohio EPA.

***4**
2.7.4 New 8-inch water main shall be constructed with shut off valves, a post indicator valve, and fire and domestic water connections to the building.

2.8 GAS DISTRIBUTION

2.8.1 None is required.

2.9 HEATING STEAM

2.9.1 Steam service for the building will be routed from an existing steam pit as indicated on the plans. Route new steam and condensate lines in shallow trench construction to the building as indicated. Contractor shall coordinate, in advance, the tap into the existing main with the Contracting Officer.

2.10 ELECTRICAL SERVICE

2.10.1 Building electrical service will be provided form the existing 12470-volt medium voltage overhead service line located along Newark Street (see drawings).

2.10.2 Provide a new12470: 480Y/277V pad mounted transformer. Provide 15kV riser to pad mounted transformer. Provide fused cutouts and lightning arresters on pole for new riser. Extend 480Y/277 volt service feeder in underground duct bank from the existing pole to the building as indicated.

2.10.3 The trench shall have excavation warning tape installed 1’-0” above the conduits. Contractor shall coordinate in advance the tap into the existing overhead 12470-volt service with the Contracting Officer.

2.11 COMMUNICATIONS CONDUIT

2.11.1 Communication service to the building shall be routed underground in conduit as indicated.

2.11.2 Provide 50 pair Category 6 telephone / data service cable and 6/12 fiber optic LAN service in one 4” PVC concrete encased duct bank from existing communications manhole to the building as indicated.

2.11.3 The trench shall have excavation warning tape installed 1’-0” above the conduits. Contractor shall coordinate in advance the tap in the existing communications manhole with the Contracting Officer.

2.12 UTILITY CONNECTIONS

2.12.1 All connections of utilities to existing services shall be requested in writing and shall be approved by the Contracting Officer.

2.12.2 Existing utility shutdowns shall be requested in writing and approved by the Contracting Officer. Utility interruptions may be required to be performed during the weekend (Friday, 6:00pm to Monday 6:00am).

2.13 LANDSCAPING

2.13.1 Site & soil preparation, finish grading, placement of topsoil, seeding and watering are to be included in the basic site requirements independent from the landscape / plantings requirements.

2.13.2 Landscape design, including but not limited, to selection and placement of plant materials will be required as part of the D/B Contractor's design responsibility.

2.13.3 Plantings shall be selected from the Plant Materials Schedule Drawing. Quantities of plantings to be included in the landscape design and installation are as follows:

a. Fifteen (15) –2″ caliper deciduous trees
b. Fifteen (15) – 5-6 ft. evergreen trees.
c. Thirty (30) – 18″ to 24″ shrubs
d. Thirty (30) – 36″ shrubs
e. Fifty (50) – 12″ spread ground cover
f. Twenty (20) – 18″ spread ground cover.

2.13.4 All planting beds shall be mulched upon final completion of plantings.

2.13.5 Plant materials shall be adjusted in the field to prevent conflicts with existing and proposed utility lines. It shall be the contractor's responsibility to identify and locate all utility lines prior to plant material installation. The contractor shall be responsible for repair or replacement of any utility line damaged during plant material installation.

***1**
2.14 Chain Link Fence

2.14.1 New chain link fence shall be 10ft. high zinc coated. Fence fabric shall be ASTM A392, Class 1 with a minimum coating weight of 2.0 ounces of zinc per square foot of coated surface. Fence posts shall be maximum 10ft. on center, ASTM F 1083, zinc coated. *1

PART 3 – GENERAL CONSTRUCTION REQUIREMENTS

3.1 HAZARDOUS MATERIALS

***1**
3.1.1 NOT USED.
***1**

3.1.2 Asbestos Containing Materials (ACM): The existing overhead steam line on the site is suspected to be insulated with ACM. See paragraph 2.2.6.

3.1.2.1 Asbestos Containing Material (ACM): In the event that suspect ACM not previously identified is encountered, the contractor shall immediately stop work in that area and notify the Contract Administrator.

3.1.3 Lead Containing Paint (LCP): There is no known LCP at the new building site.

3.1.4 Mercury Containing Lamps (MCL): There are no MCL at the new building site.

3.3 BUILDING CLOSURE

3.3.1 Exterior Elevations:

3.3.1 The Fully Contained Small Arms Range is the first building in an overall program to create a new 88 Security Forces Squadron Complex. The elevations provided with this RFP extend an architectural character established by the AFMC Headquarters and administration buildings located near the adjacent Gate 12B entrance.

3.3.2 The RFP concept elevations are included to provide definitive direction for the development of a Final Design for this project. The concept provided shall be developed without deviation from the architectural character established by the design. The D/B Contractor shall fully develop the Construction Documents necessary to implement this Concept Design.

3.3.2 Precast Panels:

3.3.2.1 Exterior walls shall be constructed of precast concrete panels, fabricated off-site. Precast concrete wall panels shall be designed and detailed as indicated on the drawings.

3.3.2.2 The design of the precast panels shall insure that all requirements (panel thickness, panel size, fastening and structural connections) for transportation, erection and installation without cracking, breakage or damage are addressed.

3.3.2.3 Cornice elements and wall bases may be accomplished with additional elements or formed in the concrete casting.

***4**
3.3.2.4 The color and finish shall match the exterior precast panels of Warrior Hall, Building **271**.

***4**
3.3.2.5 Exterior insulation and finish systems (EIFS) are not permitted.

3.3.2.6 All exterior precast walls shall be furred-out on the inside with 92mm by 20 gage metal studs spaced at 610mm on center. Provide R-11 fiberglass batt insulation between studs the full height to underside of the roof deck. Provide a 6-mill thick sheet vapor retarder and 16mm thick gypsum board. Tape gypsum board joints, mud, sand smooth and paint as indicated.

***1**
3.3.3 Roof:

3.3.3.1 The structural roof **over the Firing Ranges** shall be a **lightweight** concrete deck for controlling the negative air pressure within the building and for suppressing the noise of gunfire. The **remainder of the building shall be metal decking without the concrete.** The weathering and finished roof shall be a **non-structural s**tanding seam metal roof system (SSSMR), concealed fastener
***4**
system, **With appropriate waterproof underlayment.** The roof structure system shall slope toward the roof drains. Provide a 1-90 approved system with a 20 year weather tight warranty.

***4**
3.3.3.2 The concrete roof shall be comprised of steel decking spanning over steel joists with a lightweight concrete slab. All penetrations shall be sealed airtight so as to allow regulating of air-pressure inside the building. Any attachments and anchoring to the concrete shall be such that no cracks or voids will occur.

***4**
3.3.2.3 Roof insulations shall be R-21 rigid, polyisocyanurate boards mechanically anchored to the concrete slab **over the Firing Ranges and to the steel decking over the remainder of the roof**. Provide a rubberized ice and water-shield **6’ wide at building perimeter and at roof elevation changes.**
***4**

3.3.3.4 The **non-structural metal roofing** shall be laid on top of the rigid insulation and provide anchorage strong enough to hold down the metal panel system to test positive for an uplift classification of 90. Roof panel seam-clips (hold-down clips) shall be anchored directly into the concrete slab.

***4**
3.3.3.5 Roof panels shall be a minimum thickness of 22 gage **with AZ5O galvalume coating.** The panel system shall be functional for ¼” per foot or greater slope with standing seam heights of 63.5mm or higher. No battens permitted. Provide factory applied **PVDF** finish, color to match Sherwin-Williams SW2009. **Roof panels shall be mechanically seamed.**
***4**

3.3.3.6 Roof sheathing is to be provided over the entire roof surface under the 4759 UL Class 90 design permits. *1

***4**
3.3.3.7 The roof design shall include a vapor barrier and provisions to prevent condensation within the roof assembly.
***4**

3.3.4 Roof Access:

3.3.4.1 Two roof ladders and access hatches shall be provided inside the building.

3.3.5 Windows:

3.3.5.1 Frames for the windows shall be thermally broken aluminum for 1-inch thick insulated glass units. The profile shall be nominal 44.5mm to 51mm wide face by 114mm to 127mm deep, be exterior glazed and have a face cap of not more than 19mm deep. The frames shall have a Kynar factory finish (to match Devoe IM50D). All windows are in “punched” openings. Part of the window shall have an operable unit in the lower one-third of height.

3.3.5.2 The glass unit shall have an exterior glass pane 6.4mm thick laminated glass. The glass unit shall be Low-E and tinted bronze with a U-Value for Winter Night-K=1.74; Summer Daytime-K=1.88 Shading Coefficient=0.45 and Solar Heat Gain Coefficient= 0.39

3.3.6 Doors and Frames:

3.3.6.1 Exterior steel doors (at service and storage areas) shall be Grade-II, heavy duty, G60 galvanized, insulated and painted to match Devoe IM50D. Door sheet faces shall be 16 gage. All double doors shall be provided with a removable astragal (center jamb) and weather-stripping.

3.3.6.2 Frames shall be 14 gage, G60
steel and painted to match Devoe IM50D. Provide continuous rubber-bulb weather-stripping around frames, and provide rubber bottom seals on doors.

3.3.6.3 Coiling overhead doors shall be Factory painted to match Glidden 79-63, insulated, electrically operated and weather-stripped. The door bottom shall have a neoprene seal that will fit tight to the floor slab. The door weather-

strip shall be continuous neoprene and fit airtight against the door. The door opening head shall be provided with a neoprene seal that is airtight.

3.3.7 Storefront System:

3.3.7.1 Frames for the windows shall be thermally broken aluminum for 25mm thick insulated glass units. The profile shall be nominal 44.5mm to 51mm wide face by 114mm to 127mm deep, be exterior glazed and have a face cap of not more than 19mm deep. The frames shall be Kynar factory finish (to match Devoe IM50D).

3.3.7.2 The glass unit shall have an exterior glass pane 6.4mm thick laminated glass. The glass unit shall be Low-E and tinted bronze with a U-Value for Winter Night-K=1.74; Summer Daytime-K=1.88 Shading Coefficient=0.45 and Solar Heat Gain Coefficient= 0.39

3.3.8 Exterior Metals:

3.3.8.1 All exterior metal surfaces shall be finished to match Devoe IM50D.This includes louvers, window frames, doors, door frames & associated framing, and other miscellaneous exposed metals. Provide factory applied baked on finish.

3.3.9 Ornamental Gates:

3.3.9.1 Access openings in the mechanical screen walls shall be by way of ornamental gates. These gates shall be jamb mounted within the opening with hinges mounted to imbed plates. One leaf of the double-gate opening shall be provided with a door lever and locking mechanism designed for all weather conditions. The second leaf is to be provided with a flush bolt extended down into a concrete encased strike. Gate material shall be aluminum or stainless steel with the intent that maintenance is to be a minimum and rust is to be a non-issue. The design of these gates shall be by the D/B team and accepted by the base. Locks shall be keyed to Base standard “BEST” system.

3.4 INTERIOR BUILDING CONSTRUCTION

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3.4.1 Interior Doors:

3.4.1.1 Hollow Metal door types are as follows:

REGULAR DOORS – Those doors that are not shown in the Door Schedule to be Sound Rated, Sound Control or Pressure Control shall be Level 2, Heavy Duty (18 gage face sheets, also known in the industry as Grade II). Refer to the door schedule for fire rating and seal requirements.

SOUND RATED DOORS – Doors and jamb “assembly” with an STC rating, which is required to be met by the manufacturer of sound rated doors and jamb assemblies. This door may also be “Pressure Control” door and/or fire rated.

SOUND CONTROL DOOR – This is a non-STC-rated door which has insulated cores and has hardware to aid in sound control This door is to be Level 3, Extra Heavy Duty (16 gage face sheets, also known in the industry as Grade III). It may be fire rated; refer to the door schedule.

PRESSURE CONTROL DOORS – This is a door which has hardware that will provide a pressure seal. The pressure is defined in the mechanical section. This door is to be Level 3, Extra Heavy Duty (16 gage face sheets, also known in the industry as Grade III). It may also be fire rated or Sound Rated per the door schedule.

Reference the door schedule for additional requirements.

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***1**

3.4.1.2 NOT USED.

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3.4.1.3 All steel frames are to be of 14 gage steel.

3.4.1.4 Solid core wood doors shall receive a plastic laminate finish.

3.4.1.4 Door Hardware shall be standard weight stainless steel (US32D). All locks shall be compatible with Base Standard – “Best” system.

3.4.2 Interior Windows:

3.4.2.1 The only interior windows are located between the range and the range control rooms. These hollow metal steel framed windows shall be ‘sound reduction’ enhanced. Provide a thermally broken steel frame with a continuous neoprene seal between the two separate parts of the frame. Provide two panes of glass separated by a removable center stop (not a rabbit). The center stop shall be a channel 38mm x 38mm (min width) filled with silicone and set onto the frame. Provide a plumbed light of 9.8mm thick laminated clear, glass on the range control room side. And, provide a sloped pane of 12.7mm thick laminated clear glass on the firing range side. Provide 25.4mm x 57mm steel channel removable stop filled with silicone and set on the outer side of the panes of glass. Glass shall not touch any metal but be separated continuously by and set in, continuous beads of silicone. Window unit must be 57 STC (minimum) and be the product of a company regularly engaged in producing windows to reduce transmitted sound.

3.4.3 Interior Partitions:

3.4.3.1 Metal Studs and Gypsum Wallboard: Metal studs shall be 41.3mm by 92mm minimum G60 hot dipped galvanized steel, 20 gage before galvanization and spaced at maximum 406mm on center at interior partitions. Partitions shall receive 16mm thick boards. Ceilings and interior soffits/bulkheads shall receive 12.7mm thick gypsum board. All gypsum board shall have tapered or beveled edges. Provide fire resistance rated type gypsum board at fire rated partitions. Provide moisture resistant type gypsum board at ‘wet’ walls (walls with water present, including base cabinets with sinks and drinking fountains). Provide 12.7mm thick cement boards on the ‘built-up’ shower walls and on their ceilings. If a fiberglass shower stall is specified, provide moisture resistant board in lieu of cement board. Drying areas adjacent to the showers shall receive moisture resistant type gypsum board on the walls and ceilings to be painted. All partitions and ceilings to receive ceramic tile finish shall receive tile backer boards as recommended by the gypsum board manufacturer. At full height partitions, extend the gypsum board and the sound insulation to underside of structural deck above. Provide a minimum of 63.5mm thick mineral fiber sound insulation between all studs (fit tight and secure with wire to prevent sagging).

***1**

3.4.3.2 Concrete Masonry: Masonry partitions shall be as indicated on the drawings. These partitions shall be structurally reinforced with steel reinforcing bars as required by Codes/Regulations cited in this RFP. Doors, windows, frameless openings and outside corners shall receive bull-nose corner blocks. The masonry partitions shall receive horizontal joint reinforcement at 610mm on center vertically and be braced at the top of the partition according to Codes/Regulations cited in this RFP.

***1**

3.4.4 Finishes:

3.4.4.3 Ceramic Tile: Shall be provided in all restroom areas and shall be a combination of 9.5mm thick thin set type, class III abrasion resistant, .5 maximum water absorption, .5 minimum static coefficient of friction, set with organic adhesive. The ceramic tile shall be provided in a minimum of three sizes (101.6mm x 101.6mm wall tiles and 50.8mm x 50.8mm floor mosaic tiles).

3.4.4.4 Bonded Terrazzo: Terrazzo shall consist of three complimentary colors with 20% of the lightest color, 60% of the medium color and 20% of the darkest color separated by brass dividers. Provide a wood base and depressed slab as required to accommodate the terrazzo.

3.4.4.5 Resilient Floors: Resilient flooring shall be VCT, ASTM F 1066 Composition I. 3 colors of VCT shall be used to create a pattern and design that is complimentary of the architecture the respective room. Base shall be rubber type, straight in carpeted areas and cove type base in all other areas.

3.4.4.6 Carpet: Shall be tile type, multi colored loop and should be of a pattern and color that conceals stains and traffic wear. Pattern to be non-directional, with no linear or strong geometric patterns. Provide direct glue, no pad broadloom. Carpet pattern shall be non-directional (no linear or strong geometric graphic). At Entry 101, provide recessed entry mat with drains.

3.4.4.7 Sealed Concrete Floors: Main range and the M60 machine gun range floors shall be sealed concrete.

3.4.4.8 Acoustic Tile Ceilings: Suspended acoustic tile ceilings shall be 610 mm x 1219 mm.

3.4.4.9 Painting: Shall provide semi gloss alkyd latex in all areas. One prime coat and one finish coat shall be provided. No Paints containing lead and Zinc Chromate or Strontium Chromate Pigments shall be used. VOC shall comply with applicable codes.

3.4.5 Toilet Room Partitions & Accessories:

3.4.5.1 Toilet stall partitions shall be ceiling mounted; the urinal screens shall be wall mounted and all to be stainless steel.

3.4.5.2 Provide, sanitary napkin disposal units, paper towel dispensers, mirrors, coat hooks grab bars, and trash receptacles. Type and size of dispensers shall be coordinated with WPAFB requirements.

3.4.6 Fire Extinguisher Cabinets: Fully recessed or semi-recessed fire extinguisher cabinets with a stainless steel and glass finish shall be provided.

3.4.7 Interior Signage

3.4.7.1 Interior Signage (Building, ADA, Departmental, Individual, Directories, and Function Space) shall comply with the Wright-Patterson Base Facility Standard included with this RFP.

3.4.7.2 Quantities shall be based on sign types from the Base Facility Standard, Appendix B, and as follows:

a. I-1 Restroom: Required at each restroom location

b. I-2 & I-3 Room Identification: Required at all major offices, classroom, Arms Cleaning, Weapons Maintenance, FACTS, Vault, Range Entry, Range Control Room, Firing Ranges.
c. I-7 In/Out Directory: One required.
d. I-9 Nameplate: Required at each workstation/office
e. I-13 Fire Extinguisher: Required at each fire extinguisher location and as required by code.
f. I-14 Freestanding Announcement Board: One required
g. Service Identification Signs: Required at all telephones, janitor closets, and other service rooms.

3.5 FIRING RANGE

3.5.1 Firing Range Requirements (Main Range & M60 machine Gun Range):

3.5.1.1 Bulletproof Materials: Walls, floors and roof construction must be bulletproof. Interior range walls construction shall be grout filled concrete masonry units (CMU) or reinforced 3500-psi cast-in-place concrete. Minimum wall thickness for CMU construction is 300mm and 200mm for cast-in-place concrete. Wall height and construction shall be coordinated with the ceiling baffle system design to accommodate safe deflection and direct fire from a 7.62mm round. Walls shall be unpainted, sealed concrete. Cover sidewalls at the bullet trap with steel plate of the same thickness as the bullet trap. Steel plate shall extend a minimum of 7010mm forward of the leading edge of the bullet trap. Floors shall be flat sealed reinforced concrete suitable for a range application. Floor shall be a continuous pour with a smooth, dense surface. Saw cut control joints in the floor as appropriate. Construction shall be suitable for frangible ammunition.

3.5.1.2 Openings: No door, window or other opening, except as required for forced air ventilation is allowed forward of the firing line. Conceal all pipes, conduits, etc. in the walls, floor or ceiling.

3.5.1.3 Firing Lanes: Main Range Firing lanes shall be 1219.2mm wide (4’-0”) and 25m long (82’-0”). Machine Gun lanes shall be 1828.8mm wide (6’-0”) and 25m long (82’-0”). Provide a safety lane between the end firing position and the sidewall. Number each firing position from left to right as you face the target position. Numbers shall be of sufficient size and design to be clearly legible from any position in the Range Control Room. Alternate the colors at each numbered station with white letters on black placards and black letters on white placards.

3.5.1.3.1 The multi-use range uses 273,850 rounds / year. The 5.56 ball = 154,000 rounds; The 9mm ball = 119,100 rounds; The 12 guage 00 buck = 750 rounds.

3.5.1.3.2 The M60 Machine Gun Range is used an average of 15 hrs./month. Anticipated annual usage is 55,000 rounds/year. M60, 7.62mm ball, = 40,000 rounds. M249, 5.56mm ball = 15,000 rounds.

3.5.1.4 Horizontal Safety Ceiling: Main range and the M60 range shall have a safety ceiling above the firing line area. The ceiling (shield) shall be of assembled out of, steel standard lengths and widths and extend 3658mm in front of the firing line and 4572mm behind to the wall. This ceiling shall safely deflect a direct hit from a 7.62mm round. Construction shall be suitable for frangible ammunition. Construction may be of steel and plywood or steel and an acoustical material suitable for the application. Coordinate ceiling with the radial plenum for efficient airflow.

3.5.1.5 Ceiling Baffles: The remainder of the ceiling down range from *the Horizontal Safety Ceiling* shall be provided with ceiling baffles used to prevent direct fire into the roof structure, lighting, etc. by restricting the rounds to down range travel. Baffles shall be suspended from the ceiling. The angle, floor Interval and quantity of panels shall be determined by the ceiling height, range length and shooting activity. The baffle located immediately in from of the bullet trap shall be a steel guard to redirect bullets into the trap. The baffles shall be of 500+ BHN (Brinell Hardness Number, the higher the number the harder the steel) 10mm thick (minimum) or Armor Plate/300 BHN, 12mm thick (minimum). Do not use steel, carbon steel plate or low alloy steel conforming to ASTM A242/A242M or A572/A572M. They lack adequate pitting resistance and deteriorate rapidly. Provide one sheet of 19mm and one sheet of 11mm plywood facing and sound absorbing material on the steel baffles.

3.5.1.5.1 Baffles shall be tested prior to installation. Test shall be performed with 7.62 mm ammunition. Construct test baffles prior to fabrication and installation of the final baffles. Test baffles shall not be installed in the range.

3.5.1.6 Dry Funnel Chamber Bullet Traps: Main range (pistols, rifles and shotguns) and the M60 (7.62 mm) machine gun range shall each be provided with a self-supporting Dry Funnel Chamber Bullet Trap. Other types of Bullet Traps (Wet Funnel, Escalator, Venetian Blind, rubber composite or granular, angled backstop) are not acceptable.

3.5.1.6.1 Each trap shall be rated, at a minimum, for handguns up to 45caliber, M16, M60 (7.62 mm/158-grain ball), M249 SAW (5.56 mm) machine guns at, 12-guage shotgun slugs, rifles and frangible ammunition. Traps shall be steel plate treated to 500+ BHN (Brinell Hardness Number, the higher the number the harder the steel) 10mm thick or Armor Plate/300 BHN at 12 mm thick (minimum). Metal backstops, plates and traps shall conform to MIL-A-12560 Armor plate, steel, wrought, homogeneous, that has been heat-treated. Do not use steel, carbon steel plate or low alloy steel conforming to ASTM A242/A242M or A572/A572M. They lack adequate pitting resistance and deteriorate rapidly.

3.5.1.6.2 Traps shall be of low maintenance construction, suitable for high volume use, self-supporting, and prefabricated for on-site assembly. End plates and upper primary impact plates shall be included and integral to the trap. End plates will be provided for both wall ends of the traps such that any bullets fired along the walls will be directed into the trap. There shall be no bolts or fasteners exposed to direct or indirect line of fire.

3.5.1.6.3 Traps will be divided into spaces corresponding to the shooting lanes so that targets are approximately centered on their respective impact plates. No joint should be horizontal or located directly behind a target. The impact plates shall abut tightly or be fitted with cover plates at the joints. There should not be any gaps between the plates.

3.5.1.6.4 Trap deceleration units shall employ a mechanically driven active filtration system to capture and remove airborne lead particles within and surrounding the chamber. The trap deceleration unit should have 2-3 levels of filtration and/or a reverse pulse system to keep filters clean. System must be designed for the containment of airborne lead and provided by same manufacturer of bullet trap system.

3.5.1.6.5 The primary impact plates shall be positioned at an incline/decline angle (20 degrees from horizontal recommended) sufficient to reduce backsplatter at the trap.

3.5.1.6.6 Each bullet trap shall be a contiguous, single element extending tight to the sidewalls. Bullet trap shall extend from the range floor to the highest bullet path expected from the firing range.

3.5.1.6.7 Steel-sheets constructed in a gently sloping funnel design shall direct rounds into a deceleration chamber. Bullet particles shall be deposited from the deceleration chamber into a collection system.

3.5.1.6.8 Projectile collection system shall have a convenient system mounted onto the collection chamber to deposit bullet particles in small buckets.

3.5.1.6.9 Containers shall meet all applicable State and Federal requirements for the transportation of hazardous wastes. Containers shall be weatherproof, corrosion resistant and air tight. Containers shall be interchangeable and suitable for reuse. Container size shall be limited to accommodate a maximum of 50 lbs when full.

3.5.1.6.10 Each bullet trap and its associated systems shall not introduce any chemical additive or material, or otherwise compound or alter the bullet waste product. The raw waste product shall not be rendered less suitable for the recycling process. Any introduction of toxic substances is prohibited.

3.5.1.7 Bullet Trap Lead Dust System: Provide a lead dust removal system (one for each firing range) at the bullet trap collection chamber to convey the particulate by high velocity air through ductwork to an outdoor high efficiency (90% minimum) HEPA filtration dust collection chamber. The dust collection chamber and the vacuum fan shall be located outdoor in the mechanical area behind the firing range. The collection chamber shall be capable of depositing the fallout particles in a steel drum that can be closed with a lid and shipped off site for proper disposal or recycling. System should be interlocked w/ other air systems and target/range control system to prevent startup of any components if pre-filters are approaching full rating.

3.5.1.8 Shooting Booths. The shooting booths are only found in the main range and they shall be constructed of clear, Lexan panels. The booth shall not extend more than 305mm in front of the firing line and 460mm behind the firing line to avoid restricting the view of the range officer. The booth is to be equipped with a drop-down shooter’s shelf, individual target control unit, range condition signal light system, and interactive speakers connected to the range control room.

3.5.1.9 Target Carrier System: The retrieval system in the main range shall be a fully programmable target carrier that travels along an overhead steel track that provides a stable platform for target presentation. The target carrier can rotate the target in 180-degree direction, stop at 1-foot intervals, and contain on-board target light with built-in dimmer. The carrier shall be programmed and operated by a remote control unit in the range control room. Target rails shall be installed at a height above the floor in accordance with the Manufacturer’s recommendation. Carrier shall be capable of handling various target frames and heights.

3.5.1.10 Target Control Systems: Each system (main range and machine gun range) shall be a PC-based, Windows 2000 application that can control the targets, security, ventilation and lighting systems. It shall allow range control

personnel to write and store training scenarios, which can be downloaded to multiple or individual control units, or operated from a central range control room

3.5.1.10.1 Minimum requirements for each system: desktop computer, “Pentium 4 2.8Ghz processor, 1024MB of PC 1066 Rambus RAM, four (4) 120GB hard drives w/ ATA100 w/RAID backup, two (2) 450 mm LCD Monitors, Microsoft Windows 2000 operating system, Range interface adapter, CD-RW 48X16X48X, network printer, Range Interface Adapter, PC to RIA serial cable and CD Rom.

3.5.1.10.2 Systems shall allow either the range operator or individual shooter to operate the target system. Control system shall have two modes of operation; one mode for target movement/programming/testing that does not require operation of AHU’s and one mode that requires proper AHU operation.

3.5.1.10.3 Individual Control Units shall allow for local shooter control. Shooters shall be capable of entering a sequence of commands for the target system to perform. An LCD display shall prompt the shooter for sequence events. Unit shall also be capable of operating in direct mode, i.e. without a program sequence.

3.5.1.10.4 The Range Room Control Consoles shall be desk top units with master power switch, signal bell switching, range timer system and, firing line security system, signal light system, target lighting control, range master call control and activities control. Each lane shall be represented by a switch on the control console allowing the range operator to select individual lanes for local control by the shooter while retaining control over the other lanes.

3.5.1.11 Audio / Visual Communications Systems: Main range and the M60 machine gun range shall each have an independent system that will allow it’s respective range control room to call, listen and converse with individual shooter, a select group, or all shooters at one time.

3.5.1.11.1 The master station shall have a channel selection panel, talk/listen release switch, All-Call button, and volume controls for outgoing and incoming communications. It shall have the option of open voice speaker or handset. Console shall have an open voice speaker and handset for privacy. Communications from the main console will be initiated by engaging a talk/listen switch (push to talk, release to listen). Provide Windows 2000 operating system. System shall be capable of supporting the future addition of a hands free wireless headset system. The wireless system shall have all of the communications capabilities outlined for the fixed speaker system identified herein.

3.5.1.11.2 Each shooting station shall have an audio terminal in the shooting stall to receive and send voice communications. A call tone shall alert the shooter of a transmission from the Range Control Room. Call initiation by the shooter to the main console shall be by depressing a call button on the local terminal. An electronic tone is sounded on the main console and an LED channel selection light is illuminated.
Shooter responds by hands-free operation.

3.5.1.11.3 Provide a Range Condition Signal Light System. System shall be located on each shooters stall. System shall consist of three colored lights, a range masters call switch and control from the main console. Lights shall be red, green and amber. System shall be interfaced with the Range Security System to activate the red light when there is a security violation.

3.5.1.11.4 Provide PA system (one for each range)operated from within its respective range control room. This PA system is independent of the building PA system operated via the telephone system

3.5.1.12 Lighting: Provide general, direct, task and special lighting as described herein General lighting levels shall be 50 foot-candles at 1220mm above the floor. Direct lighting shall provide 100 foot-candles on the targets. Task lighting should provide 60 foot-candles on the firing line. Area lighting from behind the shooters shall be at least 50 to 100 fc from a fluorescent source.

3.5.1.12.1 All lighting shall be placed outside the line of fire.

3.5.1.12.2 Direct Target lighting shall be installed on swivel joints to allow for adjustment. Lights shall be located to provide the required illumination at each major target stop per lane (7m, 15m & 25m).

3.5.1.12.3 A small on/off light with a minimum luminance of 5 foot-candles shall be provided at each shooting booth.

3.5.1.12.4 Red & Blue Police Strobe Lights: Provide three Multicolor strobe-type police car lights (standard police cruiser light bar) located in the ceiling to simulate emergency conditions at night. These lights shall be installed above the ready line, centered between lanes 3 &4, 10 & 11, 17 & 18. Units shall have an on / off control from the Range Control Room.

3.5.1.12.5 Lighting Method: The required method for range lighting is a continuous bank of fluorescent fixtures with supplemental halogen or a combination of these lights running the full width of the range. All fluorescent fixtures shall have PC compatible parabolic lenses to concentrate light on the horizontal plane and reduce glare on wall surfaces. Use fluorescent fixtures to illuminate the area behind the firing line.

3.5.1.12.6 Where fluorescent fixtures are used, select lights with a color-rendering index of at least 85 and a temperature index of 3500 Kelvin, or install other light sources to balance the colors.

3.5.1.12.7 Range, Firing Line, Ready Line and target illumination needs to be dimmable to satisfy training requirements at different light levels.

3.5.1.12.8 Safety Requirements: Lights must be installed behind the bullet trap to assist in maintenance and cleanup. Ensure that downrange lighting is interlocked with the ventilation system and that emergency lights, and “exit” and “Range in Use” signs are installed.

3.5.1.13 Test Fire Certification Requirements: The Contractor shall coordinate the requirement for a range test fire and certification to be performed by Government personnel. Test and certification shall be performed prior to Beneficial Occupancy by the Government.

3.6 OTHER REQUIREMENTS

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3.6.1 Arms Vault:

3.6.1.1 Vault construction shall be:

a. Walls shall be 200 mm CMU with No. 4 rebar through all cells and all cells grouted solid, with horizontal joint reinforcement at every course.

b. Floor shall be minimum 200 mm concrete reinforced with two grids (top and bottom) of # 4 bars on 225 mm centers both ways.

c. Roof shall be minimum 200 mm concrete with a minimum reinforcing as indicated above for the floor.

d. Miscellaneous openings (for duct work, etc) shall be protected by minimum 9.5 mm hardened steel rods vertical at a spacing of 100 mm maximum. Horizontal rods shall be spaced such that open areas do not exceed 0.02 sq m.

3.6.1.2 Vault Door: Provide a security vault door, GSA approved Class V with combination lock. Door lock shall be a GSA approved built-in three position changeable combination door lock meeting UL Standard 768 Group I (reference (g)). X0-8 locks are not acceptable.

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3.6.1.3 Provide an Intrusion Detection System (IDS) for the Arms vault. A balanced magnetic door switch shall be provided on the door. A Passive Infrared (PIR) motion detector shall be provided inside the vault. Provide an access keypad at the door. IDS alarm shall be transmitted via telephone line to the Security Police Headquarters. Provide an uninterruptible Power Supply (UPS) for the IDS system.

3.6.1.4 The vault shall have a separate storage area within that will secure ammunition. The ammunition room shall be woven wire fencing structure extending from the floor slab to the underside of the ceiling. The ammunition room shall have a sliding locking steel cage door with a pass through.

3.6.2 Degreasing Sink:

3.6.2.1 One stainless steel, single bowl scullery sink, with one drain board is to be provided. This sink will NOT have water supplied to it and will NOT have a drain line to the sanitary system. Provide a valved drainpipe to extend down to within 614mm from the floor to allow a bucket to be placed under the drain outlet. Provide a stainless steel shelf over the sink at 1524mm above the floor. Provide paper towel dispenser and hand soap dispenser above the sink. Coordinate with Plumbing in section 6.6.5.

3.6.3 Service Sink:

3.6.3.1 One stainless steel, single bowl scullery sink, with one drain board is to be provided. This sink will have hot and cold water supplied to it and a drain line that connects to the sanitary system. Provide a stainless steel shelf over the sink at 1524mm above the floor. Coordinate with Plumbing in section 6.6.5.

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3.6.4 Foot Grilles in Entry Vestibule 101

3.6.4.1 Aluminum Foot Grilles: 8’-0” by 10’-0”, Standard foot grilles with extruded members, topsurfaced tread rails, and as follows:

- **Tread Rails: Extruded-aluminum frame.**
- **Tread Rail Spacing” 1-1/2 inches (38 mm) o.c. with 1/8 to 3/16 inch (3 to 4.8 mm)_ wide openings between treads.**

- **Aluminum Finish: Clear anodized.**
- **Top Surface: Fusion-bonded, level cut pile nylon carpet insert, ¼ inch (6 mm) high, 28 oz./sq. yd. (950 g/sq.m)**

3.6.4.2 Drainage Pit Applications: Provide manufacturer's special deep-pit frame and support extrusion system with intermediate support beams, sized and spaced as recommended by manufacturer for indicated spans and equipped with vinyl support cushions.

3.6.4.3 Provide manufacturer's standard 0.060 inch (1.5mm) thick, aluminum sheet drain pan with NPS2 (DN 50) drain outlet for each floor grille unit. Coat bottom of pan with protective coating recommended by manufacturer.

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PART 4 – COMPREHENSIVE INTERIOR DESIGN REQUIREMENTS

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4.1 GENERAL:

4.1.1 The design for all CID items outlined in Part 4 are to be included as part of the base bid. The procurement / installation of the items specified **in paragraph 4.2 (Systems Furniture) and the acceptance, storage and installation of free-standing furniture (para. 4.3) is a bid option. Signage shall be provided under the Base Bid.**

4.1.2 The CID shall include, Furniture, Freestanding Furniture, Interior Signage, audio/visual furnishings, **wall hangings, window treatments and other elements necessary for a normal business environment.** Any manufacturer references, style numbers, catalog numbers etc. referenced herein are for reference and quality information only. These references are not intended as a final product selection. **The Contractor shall select the Freestanding Furniture from sources identified by the Contracting Officer after award.**

4.1.2.1 The contractor shall provide the services of a professional interior designer to develop a Comprehensive Interior Design (CID) proposal that integrates the exterior architectural character of the facility with the internal layout, function and finishes. The design proposal shall include all fixtures, furnishings, displays and all items necessary to convey a continuous theme from the facility entrances through to the corridor and entry vestibules. Corridor ceiling improvements should be coordinated with the proposed lighting and preserve, as much as possible, the natural sunlight gained through elerestory windows. One possible concept is to use architectural specialties such as architectural suspended ceiling systems to simulate range baffles at the vestibule and adjacent corridor. The interior design shall be subject to review and correction, as further indicated in Section 01021.

4.1.2.2 CID is not required for the range proper, the arms vault, arms cleaning, or weapons maintenance. However, color and finish boards for these areas shall be coordinated with the remainder of the facility.

4.1.2.3 the CID designer shall have knowledge of and experience with Government supply sources for furposes of selecting items to be purchased by the Government.

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4.1.3 The requirements outlined in the RFP are provided as a reference and guide to generally define the layout, quality, materials, and quantity of the CID items.

4.1.4 Refer to the drawings for general information regarding CID programmatic requirements. The RFP drawings indicate the general layout and quantity of items to be provided. The layout provided, is included for general guidance only and is not intended to represent a complete design. Contractor shall meet with the Government to review the general layout and further define the programmatic requirements. The quantity of workstations will remain the same, however modifications to the layout will be required to further define and meet the programmatic needs of the building occupant.

4.1.5 Typical furniture product requirements are included at the end of Section 01020 for REFERENCE. This information is provided to assist in defining the quality and compatibility required in designing, procuring and installing new product for this Project. This information should not be considered a definitive cataloging of the furniture components required for this project.

4.1.6 Contractor shall review and use the following criteria in developing a CID package for this project:

ETL 90-7 Air Force Interior Design Policy (Oct 90)
AFMC Facility Quality Program (Apr. 96)
Wright-Patterson AFB Base Facility Standard
Air Force Center for Environmental Excellence, Interior Design Publications (www.afcee.brooks.af.mil/DC/DCFORM.HTM)

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4.2 SYSTEMS FURNITURE (Bid Option)

4.2.1 General Information:

4.2.1.1 The procurement, delivery, installation and fit-up of all systems furniture (total of nine workstations) will be a Bid Option as defined by the solicitation bidding requirements. All design associated with the Systems Furniture shall be included as part of the Base Bid requirements.

4.2.1.2 Generic individual workstation "Typicals" are provided in the RFP for general guidance in the design and selection of the Systems Furniture. A complete design shall be developed applying the RFP "typicals" to the established building layout. The Contractor shall coordinate with the Government during design to develop the application of the "typicals" for the established footprint. (SEE ATTACHED TYPICALS AND COMPONENT LISTING AT THE END OF THIS SECTION.)

4.2.1.3 This specification establishes the minimum requirements for the acquisition of all labor and materials required for the installation of a complete and usable system of demountable and relocatable workstations composed of a panel-based system, components, hardware and accessories.

4.2.1.4 Installation shall include all items necessary to provide a complete and functioning work environment including accessories, work surfaces, shelves, bins, pedestals, but not limited to all power connections between workstations and the building electrical distribution system.

4.2.1.5 The summary of the workstations and components for the total installation is as follows: See attached sheets for workstation types/typicals.

4.2.1.6 The systems furniture workstation requirements/attributes shall be in accordance with the furniture typical shown in the contract drawings.

4.2.1.7 The Contractor shall be responsible for all design, furniture acquisition and installation costs associated with bringing into compliance with the contact drawings and specifications all differences not identified by the Contractor or approved by the Government.

4.2.1.8 The completed installation shall comply with the current edition of the Uniform Federal Accessibility Standards, the Americans with Disability Act (ADA), and NFPA Life Safety Code.

4.2.2 General Product Requirements:

4.2.2.1 The panel system shall provide the work surface and establish the structural foundation of the workstation. Additive components shall accommodate the needs for storage, privacy, power cable distribution, and accessorization.

4.2.2.2 All workstations shall be fully flexible to permit easy assembly and disassembly by Government personnel. Back-to-back workstations shall be assembled in such a manner so that components may be completely removed from one side without disturbing the other side. Station configurations should conform to standard manufactured components. The system shall be capable of being installed on top of finished flooring without penetrating the finished floor or using floor fasteners.

4.2.3 Warranty:

4.2.3.1 Refer to Section 12705 for performance and warranty requirements. Warranty conditions will not apply to materials or components which are damaged by abuse or misuse by the Government.

4.2.4 Training Program:

4.2.4.1 The Contractor shall train (one 8-hour session) Government personnel on installing, reconfiguring and maintaining the systems furniture. Training shall be provided for adjustable ergonomic features of the workstation components and seating. This training shall be provided on site at no additional cost to the Government and at a time mutually agreed upon between the Contractor and the Government.

4.2.5 Work Surfaces:

4.2.5.1 Work surfaces shall be available in nominal of 600 mm and 750 mm. (Verify and list all required widths, but permit reasonable dimensional tolerances where possible). Work surface height shall be 713 mm to 750 mm from the finished floor.

4.2.5.2 Work surfaces shall be available in a variety of lengths from 600 mm to 1950 mm all in nominal thickness not to exceed 38 mm.

4.2.5.3 Work surfaces shall be either fully supported from panels or supported jointly by the panels, pedestals or furniture end panels.

4.2.5.4 Work surfaces shall have a finished top surface of high-pressure plastic laminate or wood veneer and shall have a smoothly furnished underside. End panels and back panels shall be a factory baked-enamel finish.

4.2.5.5 The work surface shall not be affected by ordinary household solvents, acids, alcohols, or salt solutions and shall be capable of being wiped clean with ordinary household cleaning solutions.

4.2.5.6 Work surfaces shall be capable of accepting adjustable keyboard and mouse pads. The keyboard and mouse pad should fully recess under work surface and extend to give user full access to the keyboard and mouse pad (approximately 250 mm). Side travel rotation shall be a minimum of 300 mm and 375 mm in each direction, with 180 degrees swing. Keyboard tray is to have negative and positive tilt capability.

4.2.5.7 Grommets or access channel must be able, where required, to provide access to the work surface for cable and electrical cords. Provide a minimum of one grommet per work surface.

4.2.5.8 Abutting core units shall mate closely and be at equal heights when used in side-by-side or side-to end configurations in order to provide a continuous and level work surface.

4.2.6 Pedestal and Lateral Files

4.2.6.1 Pedestals shall be freestanding or support work surfaces. Pedestal widths shall be from 175 mm to 450 mm.

4.2.6.2 Leveling glides shall be provided on base of pedestals and lateral files to install pedestals on uneven floors.

4.2.6.3 Drawers, lateral file drawers and drawer pedestals shall be of steel construction with a factory-baked enamel finish. Color shall match metal trim. Drawer faces may be of steel construction and shall be securely attached with screws to the steel drawer front. Drawer faces shall coordinate with metal trim or selected wood veneer.

4.2.6.5 All file drawers shall have full-extension ball bearing suspensions that does not expose user to grease or edges/corners that will damage users clothing.

4.2.6.6 All 152 mm box drawers shall have a minimum of one adjustable drawer divider.

4.2.6.9 All 305 mm file drawers shall be equipped with an adjustable file compressor.

4.2.6.7 All overhead cabinet doors should be able to be operated by a seated person. Equalizers that prevent doors from pinching when operated from other than center balance points are preferred.

4.2.8 Locks & Keying:

4.2.8.1 All drawers, overhead cabinets, and file bins shall have keyed locks, unless otherwise noted.

4.2.8.2 Changeable lock cylinders shall be provided with a minimum of 100 different key options.

4.2.8.3 All locks within a workstation shall be keyed alike. All workstations shall be individually keyed.

4.2.8.4 All central wall and storage units which are grouped together but are not part of a workstation shall be keyed alike, unless otherwise noted.

4.2.8.5 Keys and lock cylinders shall be numbered for ease of replacement. A key schedule shall be submitted to the contracting officer at project completion.

4.2.8.6 All locking equipment must be clearly labeled/tagged as to the workstation, key number and its location.

4.2.9 Other Components and Accessories:

4.2.9.1 The Contractor shall provide all brackets, supports, hangers, clips, connectors, adjustable feet, cover plates, stabilizers and other miscellaneous hardware required to provide a completed assemble.

4.2.9.2 Wall Tracks shall be provided in pairs where components are required to hang on wall surfaces. Tracks shall be of heavy-duty extruded metal finish and color to match panel trim and shall be slotted on 25 mm centers in heights required. (Slot spacing should match slot spacing for all panels. Identify required heights.) Coordinator with Contracting Officer the necessary in-wall blocking necessary to support the wall hung components.

4.2.9.3 Paper Management Units shall be provided, one set-up in each office and workstation. These units shall, at a minimum, consist of a four to five slot diagonal paper storage unit and two paper trays (letter size). Unit shall be either freestanding or wall mount to rear of the core unit by pins inserted into the accessory rail. (Accessory rail length is to be a minimum of three to four feet. Finishes are to match open office furniture trim color). Accessory Rails shall be equal in length to the work surface and constructed of metal with a factory-baked enamel finish.

4.2.10 Electrical:

4.2.10.1 All connections within the electrical systems must be keyed. All electrical products/components must be UL (Underwriters Laboratories) listed.

4.2.10.2 Wiring harness shall be an eight wire, 3 single phase circuits for each group of four (4) workstations. This system should provide a separate neutral for each circuit, and an independent grounding conductor.

4.2.10.3 All primary raceways shall have capacity for three 20 amp power circuits and the equivalent of ten 25-pair communication cables. Secondary raceways shall have sealed raceways capable of distribution of three 20 amp power circuits.

4.2.10.4 All 750 mm and wider raceways shall have a minimum of two knockouts of three 20 amp power circuits.

4.2.10.5 Base covers shall be securely mounted to raceways but permit easy access to the raceway.

4.2.10.6Primary raceway base covers shall not be secured by magnets.

4.2.10.7 End covers or connectors shall be provided as required and shall match the finish and color of the connecting primary and secondary raceways.

4.2.10.8 Each powered primary raceway shall have a minimum of two single duplex 15 amp grounded electrical receptacles.

4.2.10.9 All receptacles shall be commercial grade and identified easily by circuit number.

4.2.10.10 The contractor shall determine the number of circuits and the circuit capacity for all systems furniture workstation configurations.

4.2.10.11 Internal primary raceway-to-primary raceway-to-secondary raceway power connections shall be straight or flexible plug-in and plug-out grounded connections.

4.2.10.12 Power and communication wiring shall be supplied to the primary raceways either by top feed or base modules.

4.2.10.13 Base-feed modules shall supply power to the primary raceways by plugging into a receptacle (or slot on a single primary raceway). Module shall have a minimum four-foot whip for hard wiring to the building electrical system.

4.2.10.14 Communication cables shall feed through a flexible channel guard running the length of the primary raceway.

4.2.10.15 Components for vertical and horizontal wire and cable management and concealment system shall be available as indicated on the contract drawings and where use requirements dictate.

a. Vertical wire managers and concealment system shall be available on all core units.

b. Wire managers shall be prefinished and shall secure, conceal and accommodate outlet cords as well as electrical and communication wiring.

4.2.10.17 The entire electrical system shall use copper wiring, shall be Underwriters Laboratory listed, and shall meet the applicable requirements of the National Electrical Code.

4.2.10.18 A licensed electrician shall make all hard wire connections to the building electrical distribution system as shown on the contract drawings and in accordance with the National Electrical Code.

4.2.10.19 Where required, workstations communications wiring shall meet security separation requirements.

4.2.10.20 Contractor is to determine power distribution, outlet quantities and location requirements with contracting officer and user groups. A minimum of one duplex outlet per side for every powered 900 mm W core unit and two duplex outlets for core units 1050 mm and wider.

4.2.11 Task Lighting:

4.2.11.1 Task lights shall be provided for every workstation. Task lights shall be a standard component of the manufacturer's system furniture products.

4.2.11.2 Task light reflector shall be white for maximum reflection.

4.2.11.3 Task lights shall have structurally sound mounting which will prevent accidental removal but which can be easily removed and replaced.

4.2.11.4 All fixtures shall be Underwriters' Laboratory listed for use in the systems furniture configurations required.

4.2.11.5 Each fixture shall have an easily accessible on-off switch and one rapid-start ballast. Ganged fixtures or shared ballasts shall not be used.

4.2.11.6 All fixtures shall be provided with energy efficient ballasts and lamps. (Provide a list of lamps and identify sizes and coloration.)

4.2.11.7 All fixture diffusers, grilles or other covering shall be easily removable to permit cleaning and replacing.

4.2.11.8 Each fixture shall have a minimum <u>six-foot</u> factory installed heavy-duty electrical cordset with a grounded plug.

4.2.11.9 A vertical wire manager shall be available for each task light.

4.2.12 Communications Requirements:

4.2.12.1 All telephone and data connections and wiring throughout the systems furniture raceways shall be accomplished by the contractor's communications personnel.

4.2.13 Finish Materials:

4.2.11.1 Finishes shall be equivalent to the following materials:

- **a. Work surface: Plastic Laminate with soft edge treatment.**
- **b. Work surface (all PO/Offices): Wood/Veneer with soft edge treatment.**
- **c. Desk Support Structure: Paint**
- **d. Utility Distribution Channels: Paint**
- **e. Overhead Cabinets and Supports (All Workstations): Paint, Painted on overhead doors or fabric doors.**
- **f. Overhead Cabinets and Supports (PO/Office): Wood/Veneer on overhead doors.**
- **g. Pedestals: Paint**
- **h. Pedestals (all PO/Offices), Wood/Veneer on drawer fronts.**
- **i. <u>Keyboard Shelf: To be selected from manufacturers standard finish offering.</u>**
- **j. <u>All miscellaneous finish selections are to be coordinated.</u>**

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4.3 FREESTANDING FURNITURE ACCEPTANCE, STORAGE AND INSTALLATION (BID OPTION)

4.3.1 General:

4.3.1.1 The Government will purchase the Freestanding Furniture and have it delivered to the contractor. As part of the furniture option, the Contractor shall be responsible for the coordination of furniture delivery, receipt and

storage of the furniture, checking all items for damage, correctness and completion of the order, unpacking, delivering, installing, cleaning, adjusting, and leveling all furniture, and cleaning up the job site. Additionally, the Contractor shall provide "as-built" documents of the final installation to the Government. **All design associated with the Freestanding Furniture shall be included as part of the Base Bid requirements**.

4.3.2 Submittals:

SD-04 Drawings; GA

4.3.2.1 At the project completion, the Contractor shall provide the Government with as-built drawings showing accurate installation locations with item numbers corresponding to those in the freestanding furniture schedule.

4.3.3 Delivery, Storage and Handling:

4.3.3.1 Acceptance At Site: For all Freestanding Furnishings, the Contractor shall examine furniture at site for damage or blemishes. Reject all substandard items. The Contractor shall check the furniture for completion of the orders and for correctness of the shipment. Correct all problems promptly to insure a smooth and timely installation.

4.3.3.2 Storage and Protection: For all Freestanding Furnishings, the Contractor shall provide heated and weather protected enclosures as required to protect furniture from damage due to warping, staining, moisture condensation or any other environmentally induced damage. Such storage shall be for a period not to exceed six weeks.

4.3.4 Project Conditions:

4.3.4.1 Environmental Requirements: For all Freestanding Furnishings, the Contractor shall not install until all finish work is complete and permanent HVAC system is in operation.

4.3.5 Installation:

4.3.5.1 Interface with Other Products: For all Freestanding Furnishings, the Contractor shall coordinate delivery and installation schedule such the installation occurs in a timely fashion without delays. The Contractor shall coordinate the installation with the government.

4.3.5.2 For all Freestanding Furnishings, the Contractor shall level all furniture, including tables and files and bolt all files in a row together.

4.3.6 Cleaning:

4.3.6.1 For each Freestanding Furnishings, the Contractor shall remove debris and packaging at the end of each day, clean furniture with commercial cleaners, remove any soiled spots, and replace furniture damaged beyond repair or cleaning.

4.3.6.2 For all Freestanding Furnishings, the Contractor shall level all furniture, including tables and files and bolt all files in a row together.

4.3.7 Protection:

4.3.7.1 For all Freestanding Furnishings, the Contractor shall protect furniture from damage and soiling until completion of project, by installing adequate cover of non-staining material.

PART 5 - STRUCTURAL REQUIREMENTS

5.0 BUILDING STRUCTURAL REQUIREMENTS:

5.01 General code provisions, dead, live, snow, seismic and wind loads shall be according to The International Building Code (IBC 2000).

5.02 The seismic Use Group and corresponding performance level will be:
Seismic Use Group: I Standard Occupancy Structure
Performance Level: Life Safety 1

5.1 Foundations: Foundations include all substructure elements supporting the facility and its equipment.

5.1.1 Prepare the foundation design in accordance with the D/B Contractor's independently verified Geotechnical analysis of the site soil conditions performed by a licensed geotechnical engineer. Preliminary geotechnical information indicates that uncontrolled fill may be encountered in some areas at a depth of approximately two feet. Contractor shall determine the extent of existing uncontrolled fill during his geotechnical investigation. Remove any uncontrolled fill and replace with structural fill. Replacement of uncontrolled fill will be addressed through a contract modification.

5.1.2 The foundation shall be designed according to the Foundation Design Criteria stated herein, including seismic, wind, live and gravity loads.

5.1.3 Foundation Design Criteria:

5.1.3.1 Foundations shall consist of reinforced pad concrete footings and continuous strip footings unless soil conditions require the use of a deep foundation system. All exterior footings shall be a minimum of 30" below grade.

5.2 Superstructure

5.2.1 The superstructure includes the above grade structural elements required for support of the floor and roof construction.

5.2.2 The structure shall be economical, durable, sustainable, and erected on a new building foundation.

5.2.3 The structural design of building components shall conform to the design requirements stated herein, including seismic, wind, live and gravity loads.

5.2.4 All floor construction shall be slab-on-grade over a compacted drainage layer and vapor barrier. Floor elevations may vary and may require the use of retaining structures to support elevated floor areas.

5.2.5 Light gauge framing supporting floors shall not be permitted.

5.2.6 Structural wall elements required for support of roof construction include steel columns, Precast structural concrete wall panels structural concrete wall

panels and/or load bearing masonry walls. Walls will be required to function as architectural elements in addition to supporting the building loads.

5.2.7 Structural roof framing elements required for support of the roof construction includes special long span girder trusses (for firing range), open web bar joist and girders, and steel beams. The roof slope shall be in the structure. Slope may be provided by a steel truss system.

5.2.8 Roof deck over firing range shall consist of a 4-inch thick lightweight slab supported by a structural metal deck. The roof deck will also function as a diaphragm for building stability. The concrete roof deck shall provide support for a light gauge framing system to support the non-structural standing seam metal roofing. Minimum roof slope shall be 6:305 for all roof areas. All metal decking shall be galvanized. The system shall be complete with expansion control joints including sleeved penetrations for services. Show method and frequency of attachment to structural framework

5.2.9 Roof deck over remaining structure portions shall consist of a structural metal roof deck that also functions as a diaphragm for building stability. The structural metal decking shall provide support for a light gauge framing system to support the raised rib metal roofing. Minimum roof slope shall be 0.25:12 for all roof areas. All metal decking shall be galvanized. The system shall be complete with expansion control joints including sleeved penetrations for services. Show method and frequency of attachment to structural framework

5.2.10 Masonry walls will be reinforced as required. Exterior wall elements in inhabited structures will employ one-way wall elements spanning vertically to minimize blast loads on columns.

5.2.11 Give special attention to control cracking in concrete masonry structures using the guidance contained in Table 1-1.

Table 1-1 Recommended Joint Control Spacing [a]

Vertical Spacing of Joint Reinforcement With 2-#9 Wires[b] (in)	Maximum Ratio of Panel Length to Wall Height (L/H)[c]	Maximum Spacing of Control Joints[d] (ft)
None[e]	2	18
16	3	24
8	4	30

[a] Based on moisture-controlled, type I, concrete masonry in intermediate humidity conditions (ASTM C 90). The designer should adjust the control joint spacing for local conditions. The recommended spacing may be increased 6 ft. in humid climates and decreased 6 ft. in arid climates.
[b] Joint reinforcement will be cold-drawn deformed wire with a minimum 9-gauge longitudinal wire size.
[c] L is the horizontal distance between control joints. H is generally the vertical distance between structural supports.
[d] The spacing will be reduced approximately 50% near masonry-bonded corners or other similar conditions where one end of the masonry panel is restrained.
[e] Not recommended for walls exposed to view where control of cracking is important.

PART 6 - MECHANICAL

6.1 DESIGN CONDITIONS:

6.1.1 General: The D/B Contractor shall be responsible for detail load calculations and equipment selections during the design process. The loads and equipment sizing presented herein are based on preliminary block load calculations, and are intended to convey the extent of scope, and are not intended to identify specific design. D/B Contractor is responsible for preparing an independent complete analysis and design for the building mechanical systems.

6.1.2 Administration Area:

- Indoor Summer, Occupied: 23.9°C db/45%RH
- Indoor Summer, Unoccupied: 30°C db
- Indoor Winter, Occupied: 21.1°C db
- Indoor Winter, Unoccupied: 15.6°C db
- Outdoor Summer: 31.7°C db/22.2°C wb
- Outdoor Winter: -15.6°C db
- Ventilation (Outdoor Air): ASHRAE 62-1999

6.1.3 Firing Range:

- Indoor Summer Occupied: 33.3°C db (ventilation only, no air conditioning)
- Indoor Summer, Unoccupied: Inoperative
- Indoor Winter Occupied: 20°C db
- Indoor Winter, Unoccupied: 15.6°C db
- Outdoor Summer: 31.7°C db/22.2°C wb
- Outdoor Winter: -15.6°C db
- Ventilation (Outdoor Air): ASHRAE 62-1999

6.1.4 U factors (maximum values):

- Opaque Walls: 0.41 w/(m².k)
- Roof: 0.28 w/(m².k)

6.1.5 Furnish and install access doors in walls and ceilings where access is required to conceal mechanical equipment, valves, controls and other devices.

6.1.6 All mechanical equipment shall have a 2 year parts and labor warranty.

6.2 SUBMITALS

6.2.1 Operations and maintenance manuals shall include a CD-ROM for the control system that includes the software copy of all HVAC deliverable items, as well as equipment layouts, schematics, sequence of operation, software programming sheets, graphics, as-built database, and line diagrams.

6.3 STEAM AND HEATING WATER SYSTEM

6.3.1 Heating energy source will be the central district steam. The air-handling unit coils and the reheat coils shall be served by medium temperature hot water (MTHW), via heat exchange with the steam source. Since steam is not available year around, an electric immersion heater may be considered for installation in the hydronic loop, in series with the steam to water heat exchanger for the purpose of serving the reheat boxes when steam is shutdown.

6.3.2 The steam system supply conditions are 157.2 °C. and up to 482.7 kPa pressure.

6.3.3 Steam and condensate piping shall be steel, seamless for sizes 50 mm and smaller, and electric resistance welded for sizes larger than 50 mm. Steam piping shall be schedule 40 and condensate return piping shall be schedule 80. Select piping for the applied temperature and pressure conditions. Piping shall be insulated with fiberglass and factory-applied cover.

6.3.4 Size piping for nominal water velocity of 1.524 m/s, not to exceed 2.44 m/s (water) velocity nor exceed 17.9 kPa/30480 mm of pipe pressure drop. Size steam piping for nominal 40.64 m/s, not to exceed 61 m/s.

6.3.5 Design MTHW coils, pumps and piping system for 30% water/ethylene glycol mixture. Fill system with glycol mixture when system installation is complete.

6.3.5 Provide 100% backup pump for MTHW system with automatic startup if first pump does not prove flow.

6.3.6 The Garage building #879 will be disconnected from a steam source when the overhead steam line is removed. This steam source is to be replaced by a steam line extension from the CATM building. Because there is considerable underground activity on the south side of the CATM building, the most economical route from the district steam trench may be through the building. The Mechanical work shall be coordinated with the civil work to close the interface with the existing steam distribution and condensate return systems within the garage.

6.4 AIR HANDLING SYSTEMS

6.4.1 Firing Range Air Handling Units:

6.4.1.1 Package Makeup Air Units (MAU) with Energy Recovery. Provide unit that supplies a constant volume 100% outdoor air supply that recovers heat from the exhaust airflow. The supply air shall be filtered (30%), temperature preconditioned by an energy recovery exchanger, and heated by a heating coil to control the supply air temperature. Exhaust air shall be filtered in three stages to meet or exceed the requirements of the Base, EPA, NIOSH and the National Ambient Air Quality Standard (NAAQS) for lead containment. The supply-air side shall be constant airflow, sized to provide laminar airflow of 23 meters per minute (mpm) velocity ±5 percent, at the firing line. Halfway between the firing line and the bullet trap the airflow shall be maintained between 1 and 10 mpm. The exhaust air shall be balanced to provide a negative pressure (-0.05±.02-inches w.g.) in the firing range space by setting exhaust-

air flow to exceed the supply-air flow by approximately 10%. This constant volume airflow condition shall be maintained. A variable volume damper assembly (damper in series with filters) shall modulate from a partially closed position to a full open position to compensate for a pressure drop increase through the filters, as the filters load up. This constant flow performance requirement can also be achieved with a variable speed fan that ramps up speed as the filter load increases. Coordinate the pressure loads with the structural engineer.

6.4.1.2 Provide two or more units to serve the 21 multi-use firing lanes (with two safety lanes); and one unit to serve the 2 M60 machine gun lanes (with two safety lanes). These units shall be located outside in the mechanical areas immediately to the south and west of the building, and arranged for easy access. Provide housekeeping pads and coordinate heating coil removal space with the wall enclosure. Coordinate equipment sizing and location with the design architect so that no equipment is visible above 117’0” elevation in the mechanical yards.

6.4.1.3 The makeup air units shall be packaged double wall type and include an intake damper section, 30% prefilter, heat recovery section, supply fan, hot water heating coil, and access sections. Heating coil shall be sized to deliver 26.7℃ (maximum) supply air temperature. Normal operating supply temperature shall be 20℃. Provide door access on both sides of the units in the fan section, before and after each coil section, and for the filter sections. The outdoor air intake opening shall be no less than 3048mm above ground level in compliance with DOD Force Protection Guidance. Take care to adequately separate the exhaust air from the makeup air intake to avoid entrainment in the makeup air. All intake air openings must be 10’ above ground or higher. Provide supply air distribution ducts to enter the building below the roof and route through the structural truss, above the baffles and the 2440 mm high shooter’s ceiling and distribute to radial diffusers that serve the firing lanes. Coordinate with architectural and structural designs. The supply and return ducts shall have sound attenuators at the wall penetrations to the building.

6.4.1.4 The MAU exhaust-air side shall include a fan section, the heat recovery heat exchanger section (common with the supply air section) and a filter section. The filter section shall be comprised of a 3-stage (30% prefilter, 85% midfilter, and a 99.97% final filter) filter section to properly manage dust retention and minimize the filter replacement cost. The exhaust pickup points shall be located at, or behind the bullet traps. The exhaust pickup in the Range shall be continuous slot across the width of the range and separated into sections to serve the MAU dedicated to the same lanes served by the MAU supply air (i.e. no common ductwork between MAU systems).

6.4.1.5 Provide hydronic unit heaters in the firing range area, sized to maintain the area at 15.6 ℃ (60℉) during unoccupied periods.

6.4.1.6 Ventilation Control System: Shall monitor space pressure relative to outdoor pressure, and provide a loss of negative pressure alarm. The controls should monitor fan and filter status, provide interlocks and safeties as required to operate the range in a safe and controlled manner.

6.4.1.7 Ventilation Commissioning: Perform ventilation assessments as follows:

- Smoke test: At the firing line, smoke test each firing station from the floor to the six foot above floor level. The smoke should move down range to demonstrate laminar flow. Document any unusual smoke patterns. If laminar flow is not achieved, adjust the ventilation system and retest. Conduct additional smoke measurements down range

to ensure adequate air velocities and patterns are maintained down range towards the bullet trap.

- Ventilation (Volumetric flow): Use a properly calibrated hot wire or vane type meter; At the firing line at each firing station, place the meter perpendicular to the floor. Take three measurements at the same height in three locations from the floor (approximately one foot, three feet and five feet above the floor) This will result in nine readings for each firing position. Average the nine readings. Use a properly calibrated grid meter; At the firing line at each firing station, place the meter perpendicular to the floor. In the center of each firing station take a measurement at three locations from the floor (approximately one foot, three feet and five feet above the floor) This will result in three readings for each firing position. Average the three readings. Compare the average at each shooting station to the design criteria of 23 meters per minute (mpm) velocity ±5 percent. Any individual reading less than 15.3 meters per minute is unacceptable.
- Static pressure measurement: A manometer or magnahelic guage can be used to check the pressure in relation to areas outside the range. A hose can be placed outside the door with at least six inches of hose outside the door or use a smoke tube at all entrances or openings into the range. Smoke should enter into the range from outside areas. The test is acceptable if smoke clearly enters into the range from outside areas.

6.4.2 General Administrative Building Air Handling Systems:

6.4.2.1 Air-Handling-Unit (AHU): Provide a double wall variable volume air-handling unit with insulated casing and energy recovery section capable of handling 100% outside air. . The unit will be located in the south mechanical room, adjacent to the outdoor mechanical area. The condensing unit will be located in the adjacent, outdoor, mechanical equipment space. The air-handling unit will include 25% - 30% filter section, energy recovery section, mixing section, hot water heating coil, direct expansion (DX) cooling coil, supply fan with variable speed motor, and access sections. Supply air will be ducted to zone variable volume terminal units with (hydronic) reheat coils and subsequently distributed to grills, registers and diffusers. Return air may be routed via plenum or ducts from grilles in each conditioned space to the air-handling unit. An exhaust fan shall draw the return air through the energy recovery section and exhaust to atmosphere. The Administration Area shall be balanced to a slightly positive air pressure supplying more air than is being exhausted through toilet exhaust. Excess supply air shall be relieved through a backpressure relief system. A night set back mode will conserve energy by setting back the space temperature setpoints, shutting down exhaust fans and reducing the minimum outside air setting to maintain a positive space pressure. During occupied periods, the outdoor air and exhaust air shall be routed through the energy recovery section. An air economizer function shall be accommodated with outside air and exhaust air dampers that bypass the energy recovery wheel. The vestibule shall be heated by a cabinet unit heater.

6.4.2.2 The Range Control Room shall be on a separate temperature control zone and shall be designed to remain pressurized with respect to the firing range.

6.4.2.3 The Main Storage Room shall be on a separate temperature control zone and shall be designed to remain pressurized with respect to the firing range

6.4.2.4 Size ductwork using equal friction criteria. Size supply air ductwork to not exceed 24.9 Pa pressure drop per 30480 mm of duct. Size return, outdoor,

relief and exhaust ductwork to not exceed 17.4 Pa pressure drop / 30480 mm. Air velocity should not exceed 9.1 m/s velocity.

6.4.2.5 Toilet Exhaust System: Provide a ducted exhaust system to serve the toilet rooms no. 119 and 120 and janitor’s closet no. 117. The exhaust fans shall be inline type and ducted to sidewall louvers. Toilet room no. 131 shall be exhausted to a power roof exhaust fan.

6.4.2.6 Arms Cleaning and Weapons Maintenance Rooms: Provide a ducted exhaust for the solvent cleaning operation and duct to sidewall louvers in the outside mechanical equipment area.

6.4.2.7 Mechanical Equipment Rooms (MER): Ventilate both MER’s with thermostatically controlled outside air. Provide hydronic unit heater to maintain minimum safe room temperature.

6.4.3 Ductwork Design:

6.4.3.1 Provide galvanized sheet metal ductwork in accordance with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards, fiberglass insulated with factory-applied cover. Insulation in exposed areas shall be rigid and insulation in concealed areas shall be flexible. Exterior ductwork shall be insulated with cellular glass and aluminum jacket in accordance with the manufacturers specification.

6.4.3.2 Ductwork should incorporate good engineering practice, including smooth elbows with an R/D ratio of not less than 1.5. Take-offs from mains shall be with expanded or conical takeoffs. Provide access doors at periodic locations in the ductwork to enable inspection and cleaning.

6.5 NOISE CRITERIA

6.5.1 Firing Range system shall be designed not to exceed an NC rating of 65.

6.5.2 General Building System shall be designed to an NC 35 for all occupied spaces.

6.6 CONTROL SYSTEM

6.6.1 The building shall have a Direct Digital Controls (DDC) system with electric or electronic operators for dampers and valves. System shall be compatible with and connected to the existing campus system via the base LAN. Use wall mounted temperature sensors to control terminal units. System to be coordinated with and incorporated into the firing range control system. The firing range target control system will not operate without proof that the respective HVAC system is operating properly and the airflow is within design limits. Air system control console shall be located in the respective range control rooms for each range. Target control system shall be interlocked with the air system and not operate without confirmed proper operation of appropriate air system. System shall be alarmed if:

- The space should exceed allowable pressure limits.
- Any fan fails to operate.
- MAU airflow falls below setpoint (Duct air flow setting shall equate to 21.9 mpm (low side tolerance of 23 ± 5%)air velocity at the firing line).
- Filters are approaching shutdown limit. Monitor differential pressure at each filter section (prefilter, mid-filter, HEPA filter)for each MAU.

Alarm at 80% of capacity and disable system at values greater than 90% capacity.

6.6.2 The firing range supply and exhaust fans shall be electrically interlocked to run at the same time. The administrative area AHU shall be controlled in accordance with an appropriate occupied/unoccupied strategy.

6.6.3 The control system shall monitor all parameters required to properly control the HVAC system and provide automatic control of all manageable devices. The control system shall monitor, record and report electricity and steam consumption.

6.6.4 The control system shall manage a staged startup of mechanical equipment. Coordinate with the electrical design engineer.

6.6.5 Control system shall be compatible with the Base standard DDC system; STAEFA or Johnson Control (METASYS). Control and monitoring points shall be compatible with the central Base EMCS system located in Building 3022. Provide interface and connection to the Base Energy Monitoring System.

6.6.6 Provide Operations and Maintenance Manuals with Cdrom containing the software copy of all HVAC items to include but not be limited to, equipment layout schematic, sequence of operations, software programming sheets, graphics, as-built database, and line diagrams.

6.6.7 Provide non-setpoint adjustable thermostats with override occupied start feature. Provide tank pressure sensor for analog input of the air compressor tank by the DDC System.

6.6.8 Provide laminated and waterproof documentation in each control panel for: bill of materials, sequence of operation, ladder schematiacs, pictorial schematic.

6.7 PLUMBING

6.7.1 Compressed air:

6.7.1.1 Compressor to be located in mechanical room #121, and have a minimum capacity of 11.8 L/s (25 cfm) at 1206 kPa(175 psi)

6.7.1.2 Provide outlets at each work station around the perimeter at the work benches in the Weapon Maintenance room, number 118.

6.7.1.3 Pipe: Type L hard copper, ASTM B88

6.7.1.4 Joints: Brazed with AWS A5.8 BcuP-3

6.7.1.5 Fittings: Wrought copper, ANSI B16.22

6.7.1.6 Valves: of compatible materials sized as required for performance and of type suitable for the application

6.7.2 Domestic Cold and Hot Water:

6.7.2.1 Connect to site domestic cold water piping entering the side of the southeast mechanical room. Design domestic hot and cold water supply, and waste and vent systems to serve plumbing fixtures shown on the Architectural drawings.

Size piping for nominal 1.22 m/s to 1.83 m/s velocity in pipes, but do not exceed 2.4 m/s and maximum pressure drop of 17.94 kPa/30480 mm of pipe.

6.7.2.2 Domestic water piping shall be type L copper. Insulate piping with fiberglass insulation with factory-applied cover. Provide valves at each branch takeoff to toilet rooms and janitor's closet, weapons maintenance area and coffee bar.

6.7.3 Roof Drainage:

6.7.3.1 Roof drains shall be internal drains with all piping below the roof insulated to prevent surface condensation.

6.7.4 Sanitary System:

6.7.4.1 Provide a soil, waste and vent system for the toilet rooms, janitors closet, floor drains and other plumbing requirements in the facility. Tie into the sanitary system.

6.7.4.2 Sanitary system piping shall be either service weight cast iron or copper. Exposed piping shall be chrome plated. Insulate exposed drains to fixtures for the handicapped and water cooler drains with insulation with factory-applied cover.

6.7.5 Plumbing Fixtures:

6.7.5.1 Install fixtures where shown on the floor plan.

6.7.5.2 Provide a floor drain with trap primer at each group of water closets.

6.7.5.3 Provide new vitreous china, nonabsorbent, commercial quality fixtures free of cracks, blisters, thin spots or other flaws. Fixtures for the physically handicapped shall be in accordance with ADA requirements.

6.7.5.4 Faucets and trim shall be chrome finished with brass and copper waterways.

6.7.5.5 Carriers shall be provided for water closets, urinals, lavatories, and water coolers.

6.7.5.6 Water closets shall be wall hung, siphon jet, elongated bowl, top spud, wall mounted. Seat shall be white plastic open front. Flush Valve shall be non-hold open feature, back check angle control stop, and vacuum breaker.

6.7.5.7 Urinals shall be wall hung, siphon jet, top spud, back outlet, privacy screen. Flush Valves shall be non-hold open feature, back check angle control stop, and vacuum breaker.

6.7.5.8 Lavatories shall be self-rimming counter type. Faucet shall be deck mounted single lever type. Drain shall be strainer type.

6.7.5.9 Water Cooler shall be dual height, self-contained, wall mounted, push pad actuation.

6.7.5.10 Service Sink shall be precast terrazzo floor mounted mop sink with stainless steel cap and 76.2 mm drain. Size shall be 914.4 mm x 609.6 mm x 304.8 mm high.

6.7.5.11 Dry Sink: Government type to comply with Federal Specification WWP-541b and current amendments. Single compartment with integral welded drainboard on left side and 38.1 mm backsplash. Sink shall be 14 gauge minimum thickness 304 stainless steel. No faucets or drain.

6.7.5.12 Scullery Wet Sink: Government type to comply with Federal Specification WWP-541b and current amendments. Single compartment with integral welded drain board on right side and 31.1 mm backsplash. Sink shall be 14 gauge minimum thickness 304 stainless steel. Faucets shall be chrome plated, 1.27 mm I.P.S. female flanged inlet, 1.9 mm, hose thread outlet.

6.7.5.12 Provide a permanently installed eye wash (fixed plumbing) in the Weapons Maintenance Room. Eye Wash shall be ADA compliant, wrap around skirt, stay-open stainless steel ball valve, twin stainless steel eye/face wash, water flow operated with hand paddle, safety sign.

6.7.5.13 Hot Water Heater: Design electric heater in accordance with ASHRAE guidelines and to be constructed in accordance with ASME Code for working pressure 1034 kPa (150 psig). Heater shall be in compliance with UL 174 or UL 1453, and listed by manufacturer for commercial applications. Heater shall be factory assembled with glass lined tank separately controlled heating elements, safety controls, drain valve, anode rod, and dip tube. Heater size is estimated to be less than 12 kW heating and 120 gallon.

6.8 FIRE PROTECTION

6.8.1 Fire protection shall conform to Federal Safety and Health Regulations for Construction (OSHA)

6.8.2 Sprinkler Systems:

6.8.2.1 Except as noted the entire building will be sprinklered as follows: Ordinary hazard, Group 2, wet system with 0.136 L/sq m design density for 278.7 sq m area of operation. Provide hose allowance of 31.6 L/s. Based on this information, the following data will be considered minimum requirements.

Sprinkler Demand	=	0.136 L/(s x m²) x 278.7 m²	=	37.9
Sprinkler Demand	x	1.30 safety factor	=	49.3 L/s
Hose Demand	=		=	31.6 L/s
Total Water Demand	=		=	80.9 L/s

6.8.2.2 Shall perform a water flow test, scheduled with C. J. Vehorn @ 257-3397.

6.8.2.3 For reference, a water flow test was performed on September 4, 2002. The flow test was performed at the fire hydrant at the corner of Newark and I Street. The pressures were measured at the fire hydrant, one block away, at the corner of Newark and Road “Z”. Test results:

- Flow = 69.4 l/s
- Static pressure = 365 kPa
- Residual pressure = 317 kPa

6.8.2.4 It is not anticipated that a fire pump will be required.

6.8.2.5 Sprinkler system must be equipped with a 4” “Storz” connection angled at 45 degrees, pointing toward the ground.

6.8.2.6 Light hazard pipe schedule sprinkler systems are not permitted.

6.8.2.7 All sprinkler systems must be equipped with water flow alarms that transmit a signal to the base fire department.

6.8.2.8 All sprinkler control valves shall be electrically supervised.

6.8.2.9 Three-foot minimum clearance required on all sides of sprinkler risers, valves, check valves and similar devices to facilitate maintenance.

6.8.2.10 Check valves and other devices requiring regular maintenance shall not be located above drop ceilings in finished areas.

6.8.2.11 Sprinklers shall be “concealed pendant mounted” type in finished areas. Valves with tamper switches and flow switches shall be provided.

6.8.2.12 Do not provide sprinkler system in rooms:

- M60 Firing Range #124
- M60 Bullet Trap area #125
- M60 Back Aisle #126
- Main Firing Range #127
- Main Bullet Trap area #128
- Main Back Aisle #129.

6.8.3 Fire Extinguishers and Cabinets:

6.8.3.1 Provide multi-purpose, dry chemical fire extinguishers and cabinets in accordance with NFPA 10.

6.8.3.2 A portable fire extinguisher rated not less than 2-A shall be provided for each 278.7 sq. m. of the construction building area, or major fraction thereof. Extinguishers shall be inspected and maintained in accordance with NFPA 10, Portable Fire Extinguishers.

6.8.3.3 Fire extinguishers listed or approved by a nationally recognized testing laboratory shall be used.

***4**
6.9 COMMISSIONING – The HVAC system and the controls system shall be fully commissioned per section 15995.
***4**

PART 7 – ELECTRICAL

7.1 EXTERIOR ELECTRICAL

7.1.1 Service Entrance: Refer to Section 01020, Part 2 for Electrical Service Entrance Requirements.

7.1.2 Exterior Lighting:

7.1.2.1 Parking Lot Lighting: Provide parking lot lighting with a general illumination level of 2 foot-candles. Lighting poles shall be spaced to provide a uniform lighting pattern and shall not obstruct traffic or parking spaces. Poles shall be aluminum. Light fixtures shall be metal halide 250 watt. Control shall be via a photocell.

7.1.2.2 Security / Egress Lighting: Provide building security / egress lighting at all entrances and exits from the building. Main entrance lighting shall be metal halide. All fixtures shall be architectural type, selected to be compatible with the building architecture. Control shall be via a photocell.

7.1.2.3 Utility Lighting: Provide security and maintenance lighting for outdoor mechanical courtyards. Lighting shall provide sufficient lighting to inspect equipment at night. A weatherproof switch located within the mechanical courtyard shall control lighting. Fixtures shall be metal halide.

7.1.2.4 Walkway Lighting: Provide metal halide bollards along the walkway to the main building entrance. Provide illumination levels in accordance with the latest recommendations of the Illuminating Engineering Society.

7.1.3 Communications: Refer to Section 01020, Part 2 for Communications Service Entrance Requirements.

7.2 INTERIOR POWER

7.2.1 Building Electrical Service:

7.2.1.1 A 480Y/277 volt, three phase building service will be extended underground into the building from a new pad mounted 15Kv, 480 volt secondary transformer. Provide 15kV riser from overhead 15KV line down pole to a ductbank connecting to a pad mounted transformer. Provide fused cutouts and lightning arresters on pole for new riser.

7.2.1.2 Provide a Service Entrance Rated Panel, with main breaker in the main building Electrical Room. Service Entrance Panel shall be wall mounted, 480Y/277V volt, three phase. This panel shall serve mechanical equipment, sub-feed to a separate 480Y/277 volt, three-phase lighting & miscellaneous load panel and feed a 480Y:208Y/120 volt transformer as described herein.

7.2.1.3 Provide a minimum of 20% spare capacity and circuit breaker space in the Service Entrance Panel.

7.2.1.4 Transient Voltage Surge Suppression (TVSS): TVSS shall be provided on the main bus of the Service Entrance Panel.

7.2.2 Building Electrical Distribution System:

7.2.2.1 Provide distribution panels (208Y/120 volt, three phase) for building general power. Panels shall be fed from the Service Entrance Panel via a 480Y: 208Y/120 volt, three-phase transformer. General power panels and circuits shall be provided as required to meet the building electrical system requirements.

7.2.2.2 Provide separate panel(s) for all lighting, equipment and general power requirements for the Main Firing Range, M60 Machine Gun Range, Range Control Rooms and Range Entry Rooms. Locate the panel(s) in the Main Range Control Room. Firing range equipment (bullet traps, targeting system, etc.) shall be provided with dedicated circuits for each piece of equipment.

7.2.3 Electrical Equipment and Devices:

7.2.3.1 Devices and equipment shall conform to the following regulatory documents:

- IEEE C37.13 Low-Voltage AC Power Circuit
- NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
- UL 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosure
- NEMA ST 20 Dry-Type Transformers for General Applications
  NEMA WD 1 General Requirements for Wiring Devices

7.2.4 Wiring Requirements:

7.2.4.1 All conductors shall be copper. Branch circuit conductors shall not be smaller than No. 12 AWG.

7.2.4.2 Conductors for branch circuits of 120 Volts exceeding 100 feet in length, and 277 Volt circuits exceeding 230 feet in length from panel board to center of load shall be not smaller than No. 10 AWG. Conduit sizes are based on the use of type THHN insulation for conductors smaller than N0. 1/0 and type THWN for cables larger than No. 1/0.

7.2.4.3 Phase conductors shall be identified by color-coding. The color of the insulation on phases A, B and C respectively (for three phase) or phases A and B respectively (for single phase) of different voltage systems shall be as follows:

- 120/208 Volts: Black, Red and Blue
- 277/480 volts: Brown, Orange and Yellow

7.2.4.4 Conductor identification shall be provided within each enclosure where a tap, splice or termination is made.

7.2.4.5 Provide a separate green ground conductor in each conduit.

7.2.4.6 All conduits shall be steel. Metallic armored cable may be used in walls.

7.2.5 Identification Requirements:

7.2.5.1 Provide identification nameplates on the following equipment:

- Panel boards
- Motor Starters
- Safety Switches
- Transformers
- Equipment Enclosures
- Motors
- Telephone and Computer Racks

7.2.6 Panel boards:

7.2.6.1 Provide a minimum of 20% spare bus capacity and circuit breaker space in all panel boards.

7.2.6.2 All panel boards shall be provided with copper busses and meet the AIC capacity required as demonstrated in the short circuit study performed by the Contractor. All new panels shall be bolt-on circuit breaker type and equipped with main breakers.

7.2.7 Systems Furniture Power:

7.2.7.1 Provide electrical service to systems furniture as required in Section 01020, Part 4. Power connections to furniture systems shall be through wall, column or floor feeds. Power poles are not permitted.

7.2.8 Transformers:

7.2.8.1 Dry type transformers serving the 208Y/120V branch circuit panel boards shall be floor mounted in the Electrical Room and isolated to reduce the transmission of vibration to the structure. Connections to transformers shall be made using flexible conduit.

7.2.9 Receptacles:

7.2.9.1 Receptacles shall be provided for general use and special equipment as necessary. No more than four receptacles shall be on a branch circuit feeding office cubicles. Receptacles feeding computer loads and special equipment shall be on separate circuits from the general and mechanical equipment circuits.

7.2.10 Special Firing Range Systems:

7.2.10.1 Provide power and control for a complete installation of the Firing Range Systems described in 01020, Part 3. Coordinate power and control requirements for all Firing Range systems with manufacturer of system.

7.3 LIGHTING

7.3.1 Fixtures:

7.3.1.1 Provide 2’X4’ deep-cell parabolic fluorescent, lay-in fixtures throughout office areas. Louvers shall be a minimum of 3 inches deep and shall have 24 cells.

7.3.1.2 Lensed recessed 2’X4’ troffers shall be provided in general spaces with ceilings that have no computer use.

7.3.1.3 Provide industrial strip fixtures with a plastic lens casing in general interior areas without ceilings such as, electrical, mechanical rooms.

7.3.1.4 Fixtures shall be equipped with high-Frequency electronic ballasts. All ballasts shall be equipped with RF suppression.

7.3.1.5 Fixtures shall use T-8 lamps with a correlated color temperature of 4100K and have a minimum Color Rendering Index (CRI) of 75.

7.3.1.6 Fixtures shall be switched in each individual room by wall switches at the entry door to the room. Light switches shall be equipped with occupancy sensors. The sensors shall be designed with the proper combination of automatic and manual lighting control to achieve maximum efficiency and energy conservation.

7.3.1.7 Exit signs shall have lettering on an opaque background. Internally illuminated signs shall be light emitting diode (LED) type.

7.3.2 Light Levels:

7.3.2.1 Light levels shall be as recommended in the Illuminating Engineering Society of North America Handbook. Minimum is as follows:

- Office/Classrooms/FACTS - 50 foot-candles
- Arms Cleaning & Weapons Maintenance - 70 foot-candles
- Storage Rooms - 20 foot-candles
- Arms Vault - 50 foot-candles
- Range Control Rooms - 50 foot-candles
- Corridors - 15 foot-candles
- Toilets - 15 foot-candles
- Stairs - 30 foot-candles
- Electrical rooms - 35 foot-candles
- Mechanical rooms - 35 foot-candles

7.3.3 Range Lighting:

7.3.3.1 See Section 01020, paragraph 3.5 for requirements.

7.4 SPECIAL SYSTEMS

7.4.1 Fire Alarm System:

7.4.1.1 The fire alarm system will be an addressable intelligent system whose fire alarm control panel is located near the building entrance. Key panels to a Master “B” keyway per Base Facility Standard. Provide Knox Box and connection from Knox Box tamper switch to FACP. Smoke detectors will be provided per NFPA 72 and 75. Provide combination audible/visible notification appliances throughout. In areas deemed not to require an audible appliance, such as a toilet room, a visual only appliance shall be provided.

7.4.2 Intrusion Detection System (IDS):

7.4.2.1 See Section 01020, paragraph 3.6 for requirements.

7.4.3 Data & Telephone System:

7.4.3.1 Provide data and telephone wiring and outlets in accordance with the requirements of the Base Facility Standard (included as a reference with this RFP). Outlet quantities shall be as shown on the drawings.

7.4.3.2 data cabling shall be Category 6. Telephone cabling shall be Category 5.

7.4.3.3 Contractor shall coordinate with WPAFB personal for the punch down/termination of cabling.

7.4.4 Lightning Protection System:

7.4.4.1 Provide a complete aluminum lightning protection system conforming to NFPA 780.

7.4.5 Grounding:

7.4.5.1 Provide a complete building grounding counterpoise system complete with ground rods.

7.4.5.2 Tie building system ground to Lightning Protection System.

PART 8 - CONSTRUCTION CONSIDERATIONS AND USE OF PREMISES

8.1 SUMMARY

8.1.1 The requirements include:

- Construction considerations and use of the premises.
- Protection of personnel and Government property.
- Construction facilities and job site standards.
- The requirements of this section apply to the entire project including all addenda or change orders that may be issued to modify the contract documents.

8.2 GENERAL INFORMATION

8.2.1 Construction Considerations:

8.2.1.1 The superintendent in charge of this work shall personally contact the Base Civil Engineering Division, Building 11, Area C, and the Contracting Officer a minimum of 72 hours before starting site operations of the contract, before resumption of seasonal work, before restarting work after a lengthy delay, and prior to moving men and equipment from one site of work to another.

8.2.1.2 Coordinate all construction activities with:

a. Project Inspector
b. Contracting Officer Representative
c. Base Fire Department
d. Security Police

8.2.1.3 Prior to the start of any construction operations whatsoever, a schedule of work or operations in proper sequence shall be submitted by the contractor for approval by the Fire Protection Branch, Security Police, Safety Office, and the Contracting Officer so as to cause a minimum amount of disruption to the normal flow of traffic on streets, pedestrian travel, base security, and facility operations.

8.2.1.4 Coordinate all Construction and Use of Premises Activities with the Contracting Officer Representative.

8.2.1.5 Contractor shall take extra care to comply with all OSHA safety regulations for his employees, subcontractors, vendors and representatives, as well as all building occupants and visitors.

8.2.1.6 Coordinate with Contracting Officer the scheduling and routing of work, personnel access and material deliveries for the work.

8.3 DOCUMENTATION

8.3.1 Construction Plan:

8.3.1.1 Prior to the start of any onsite construction activities, the Contractor shall submit a detailed construction plan. The plan shall include:

a. A detailed schedule of the major construction activities (GANTT chart or other mutually agreeable format).

8.3.1.2 Submit to the Contracting Officer’s Representative for approval, a project schedule detailing on a weekly basis when work is to begin for each major work item and what work is to be accomplished (including quantities), etc. While factors not under the Contractor's control may cause the Contractor to fall behind the schedule, the intent of the schedule is to inform the Government of planned orderly progression of the work in proper sequence. Once the schedule is approved, do not deviate from the sequence, without prior written approval.

8.3.2 Waste Disposal:

8.3.2.1 Prior to the start of any onsite construction activities, the Contractor shall submit a written plan for disposing of waste materials resulting from work under this contract. If any waste material is dumped or left in an unauthorized area, the Contractor shall remove the material and restore the area as required by the Contracting Officer.

8.4 CONSTRUCTION CONSIDERATIONS

8.4.1 Use of the Premises

8.4.1.1 Contractor shall have exclusive use of the site for construction.

8.4.1.2 Working hours for the Contractor will be Monday through Friday between the hours of 5:00 a.m. and 6:00 p.m. unless otherwise noted. No work shall be performed on Saturdays, Sundays, and Federal holidays unless otherwise stated or shown.

8.4.1.3 Work may be required to be performed after normal business hours or on weekends if it is determined by the Contracting Officer to be disruptive to the building occupancy or operations.

8.4.1.4 In general, the Contractor shall be responsible for providing portable toilet, drinking, and washing facilities for his employees and subcontractor use.

8.4.1.5 The Government will make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies. The Contractor shall carefully conserve any utilities furnished without charge.

8.4.1.6 Prior to commencement of demolition and construction, the Contractor shall coordinate daily access and egress from the area of construction with the Contracting Officer. The Contractor shall confine construction personnel and equipment travel and operations to the area of work.

8.4.1.7 Utility outages and interruptions shall be scheduled through a written request to the Contracting Officer fourteen (14) days in advance. Construction activities requiring utility outages may be required to be performed after hours or on weekends.

8.4.1.8 No power outages will be permitted without advance written approval by the Contracting Officer.

8.4.2 Egress

8.4.2.1 Contractor shall maintain a neat and orderly workplace with clear paths of emergency egress within the construction area.

8.4.3 Storage of Materials

8.4.3.1 The Contractor shall be responsible for the storage and safekeeping of all material to be incorporated into the work. The Contractor shall be responsible for all aspects of safety and security within the storage area.

8.4.3.2 Contractor shall limit storage of materials, equipment trailer, and sheds to the site-designated staging area or within the confines of the area of work.

8.4.3.4 Provide adequate storage facilitates for protection of materials and equipment. Materials and equipment shall be stored so as to ensure preservation of their quality of fitness for Work. Perishable items and items adversely affected by weather, rain, wind, dust, heat, or cold shall be stored within the designated area of construction, temporary waterproof sheds, or mobile facilities with raised floors, and heated if necessary. Other materials and equipment shall be stored on wooden platforms and not on the ground.

8.4.3.5 Storage facilities shall be clean, in good condition, undamaged and free of rust or surface deterioration. Rental trailers shall be of a neutral color. Unsightly material storage or office trailers will not be permitted.

8.4.3.6 The Contractor shall be responsible to maintain the condition of storage facilities, as defined above, and the entire construction site in a neat, orderly, professional and uncluttered manner at all times throughout the length of the contract.

8.4.3.7 The Contractor's job site trailer shall have a professionally made metal identification sign attached in a prominent location. The sign shall be 2 ft. x 3 ft. in size (with light colored lettering on a dark colored background) indicating the Contractor name, name and 24 hour phone number of someone to contact in case of emergency.

8.4.4 Security

8.4.4.1 Security requirements shall be observed at all times. The Contractor shall be responsible for maintaining satisfactory standards of employee competency, conduct, appearance, and integrity.

8.4.4.2 Construction operations shall be strictly confined to the designated area of Work.

8.4.5 Protection of Personnel and Government Property

8.4.5.1 Contractor shall comply with all applicable Federal, State, and Local safety codes, regulations, and requirements.

8.4.5.2 It is the Contractor’s responsibility to maintain a secure construction site to prevent access to the work area by unauthorized personnel.

8.4.5.3 Safety posters, “hard hat area” posters, “authorized personnel only” posters, and any other notifications required by law shall be posted and maintained in sufficient quantity to be conspicuous on the job site.

8.4.5.4 In the event of damages of any nature caused by this work due to improper protection, precaution or safety measures, such damages shall be repaired or the Contractor at no cost to the Government shall replace such property. In the event the Contractor does not satisfactorily repair or replace such damage caused by the work of this contract, the Government will make the necessary corrections and the Contractor shall reimburse the Government for inconveniences, labor, and materials, involved.

8.4.6 Fire protection

8.4.6.1 Fire protection shall conform to Federal Safety and Health Regulations for Construction (OSHA)

8.4.6.2 Fire extinguisher equipment shall be provided in storage areas according to the hazard present.

8.4.6.3 Fire extinguishers listed or approved by a nationally recognized testing laboratory shall be used.

8.4.7 Waste Disposal

8.4.7.1 The Contractor is required to maintain a clean project site free of accumulating debris. Demolition debris and other construction waste shall be promptly disposed of at the end of each workday in proper waste containers maintained on the project site by the Contractor.

8.4.7.2 Environmentally hazardous or other construction debris with special disposal requirements shall be stored on the site and disposed of off site in a proper lawful manner.

8.4.7.3 All debris shall be removed from the site on a regular basis. Waste shall not be allowed to accumulate.

8.4.7.4 Construction waste and debris maintained on-site prior to off-site disposal shall be controlled in a manner to eliminate any potential health or safety hazards.

8.4.7.5 Burning of waste or any other material on-site is strictly prohibited.

8.4.7.6 The project job site shall be “broom cleaned” at the end of each work day. The Contractor shall remove debris from the job site as it is generated and dispose of it in proper containers as outlined herein.

PART 9 – LEAD MANAGEMENT PLAN

9.1 SUMMARY

8.1.1 As part of the Part 2 design submittal, the contractor shall submit a draft Lead Management Plan to address sampling, testing, operation, maintenance and cleaning of the facility so that it remains in compliance with OSHA requirements for limiting exposure to lead and/or lead dust during operation. The plan shall be prepared by, or under the supervision of, a certified industrial hygienist. The plan shall address such issues as employee access to

contaminated areas, disposal of waste materials and filters, operation and maintenance of the ventilation system and any other lead related problems that the user will encounter in operating the range facility. The draft plan shall be subject to review and correction as indicated for the design. Before the project is substantially complete, the contractor shall update the plan to include information on actual products used in construction (manufacturer, model, etc.).

***1**

PART 10 – RENDERING REQUIREMENTS

10.1 The contractor shall provide two different perspective renderings for the project as follows:

10.1.1 “Birds-eye” or roof top perspective of the project to include as much of the surrounding area and existing buildings as necessary to depict the new facility and its contextual setting. Do not choose an angle so high that the drawing is dominated by the roof.

10.1.2 Eye-level perspective focusing on the building design and its significant architectural features. Typically, the most prominent entrance or façade is portrayed. The angle is at the discretion of the designer in these cases.

10.2 Sketch versions of the two perspectives listed above shall be submitted for review with the Part 1 design. Sketch perspectives shall be illustrated and rendered using pen and marker techniques which adequately illustrate the exterior materials, colors, and design intent. These perspectives shall be presented in no smaller than 11 inch by 17 inch format to facilitate display and storage.

10.3 Final versions of the perspective renderings shall be submitted 60 days after the Part 1 review meeting. Submit two full-sized copies (not small photos) of each final rendering; one each to the base and the second set to AFMC/CEC, through the Contracting Officer. The final perspectives shall be submitted in the following standard format to facilitate display and storage.
10.3.1 The size shall be 24 inch by 36 inch overall, including matting and frame.

10.3.2 Frames shall be bronze metal, 3/4-inch to 1-inch deep; with single matting in a neutral color which complements the drawing.

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SECTION 01331

SUBMITTAL PROCEDURES FOR DESIGN/BUILD
06/02

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-09 Manufacturer's Field Reports

Daily reports from specialty suppliers to the contractor that provide information, data, tests result for a product.

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.

SD-12 Schedules

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 Design Engineer of Record (EOR) Approved

EOR applies to individuals who have professional accountability and design responsibility for certain features of a project involving one or more engineering and design discipline, such as architectural, structural, mechanical, or electrical. EOR approval is required for all required project design submittals as identified in section 01021, extensions of design, critical materials, any deviations from the solicitation, the accepted proposal, or the completed design, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Included in this category of submittals are structural steel connections, critical fire protection and life safety items, [and commissioning of HVAC equipment whose compatibility with the entire system must be checked]. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," such submittals are considered to be "shop drawings". The Contractor shall provide the

Government the number of copies, designated in paragraph "Submittal Procedure", of all Designer of Record approved submittals. The Government may review any or all Designer of Record approved submittals for conformance to the Solicitation and Accepted Proposal.

1.2.2 Government Reviewed Design or Extension of Design

Administrative Contracting Officer review is required for all design. Government review will be for conformance with the technical requirements of the solicitation and shall take place on all design submittals. Section 01021 covers the design submittal and review process in detail.

Government reviewed submittals (not to be confused with Government approved submittals) include structural connections, life safety/fire protection and other extension of design construction submittals, and HVAC equipment commissioning where additional detail is being provided to define contract conformity. Review is not required for submittals that offer no additional details beyond that which is already shown on the construction documents. Construction documents were already reviewed and accepted in accordance with Section 01021 DESIGN SUBMISSION REQUIREMENTS AFTER AWARD. Government review shall not remove or replace design EOR design responsibility.

1.2.3 Government Approved

Administrative Contracting Officer approval is required for any deviations from the Solicitation, accepted proposal, or the accepted final design and other items as designated by the Contracting Officer's Representative. Within the terms of the Contract clause entitled "Specifications and Drawings for Construction," these submittals are considered to be "shop drawings."

1.2.4 Information Only

All submittals not requiring Designer of Record approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 CONTRACTOR RESPONSIBILITY FOR GOVERNMENT REVIEWED OR GOVERNMENT APPROVED SUBMITTALS

The Contracting Officer's Representative conformance review or approval of submittals shall not be construed as a complete check, but will indicate only that the design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Government Review or approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Design and Contractor's Quality Control (CQC) requirements of this contract is responsible for design, dimensions, all design extensions, such as the design of adequate connections and details, etc. and the satisfactory construction of all work. After submittals have been reviewed for conformance or approved, as applicable, by the Contracting Officer's Representative, 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 DESIGN SUBMITTALS

The Contractor shall provide design documents submittals in accordance with Section 01021.

3.1.1 SUBMITTAL REGISTER (ENG Form 4288)

The Designer of Record shall develop a complete list of submittals during design. The Designer of Record shall identify required submittals in the specifications, and use the list to prepare the Submittal Register. The list may not be all inclusive and additional submittals may be required by other parts of the contract. The Contractor is required to complete the submittal register and submit it to the Contracting Officer for approval within 30 calendar days after Notice to Proceed. The approved submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period. The submit dates and need dates used in the submittal register shall be coordinated with dates in the Contractor prepared progress schedule. Updates to the submittal register showing the Contractor action codes and actual dates with Government action codes and actual dates shall be submitted monthly or until all submittals have been satisfactorily completed. When the progress schedule is revised, the submittal register shall also be revised and both submitted for approval.

3.1.2 Draft 1354

The DD Form 1354 Data Sheets contain a summary of project information used to transfer the facility to the owner agency. The data sheet is divided into two parts; Facility and Features within the 5 foot line and Features outside the 5 foot line. The Contractor shall meet with Government representatives (Construction Office Representative and installation representative) at the start of design to get direction and example documents, on the format and content of the Draft DD Form 1354. The draft form will be prepared as part of the final design documents and reviewed by the Government. The Contractor will then revise the form to reflect the

comments received. At time of construction completion, the Draft DD Form 1354 will be updated by the Contractor to reflect as-constructed information. The final form is then submitted to the Government.

3.2 CONSTRUCTION SUBMITTALS

3.2.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer's Representative may require 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. See Section 00800, "AS-BUILT DOCUMENTS FOR DESIGN BUILD PROJECTS", for electronic submittal requirement for some shop drawings and other submittals. Prior to submittal, the Contractor's Quality Control (CQC) representative, and the Designer of Record, as applicable, shall check, approve and stamp, sign, and date each item, 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.

3.2.2 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.

3.2.3 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 blank forms [will be furnished to the Contractor] [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.

3.2.4 Submittal Procedure

Submittals shall be made as follows:

The Contractor shall submit to the Contracting Officer three (3) copies of all submittals of items requiring shop inspection and one (1) copy of all other submittals as called for under the various headings of these specifications.

3.2.4.1 Procedures

Detailed submittal procedures will be further discussed with the Contractor at the pre-construction conference.

3.2.4.2 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. As stated above, the Contractor's Designer of Record's approval is required for any proposed deviation. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.2.5 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" so the material needed date is not threatened.

3.2.6 Government Conformance Review and Approved Submittals

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. One copy of the submittal will be retained by the Contracting Officer's Representative and two copies of the submittal will be returned to the Contractor. If the Government performs a conformance review of other Designer of Record approved submittals, the submittals will be so identified and returned, as described above.

3.2.7 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 1.4.

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.

3.2.8 STAMPS

Stamps used by the Contractor's Designer of Record and the Contractor's designated Quality Control person on the submittal data to certify that the submittal meets contract requirements shall be similar to the following (use two stamps for submittals reviewed by both):

```
_____________________________________________
|            CONTRACTOR                     |
|            (Firm Name)                    |
|                                           |
| _____ Approved                            |
| _____ Approved with corrections as noted on |
|       submittal data and/or sheet(s).     |
|                                           |
| SIGNATURE: ___________________________    |
| TITLE: (DESIGNER OF RECORD)_______________ |
| DATE:  ______________________________     |
|                                           |
|___________________________________________|
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SECTION 15951A

DIRECT DIGITAL CONTROL FOR HVAC
12/01

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 B16.34	(199; B16.34a) Valves - Flanged, Threaded, and Welding End
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC VIII D1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

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

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA S7.0.01	(1996) Quality Standard for Instrument Air

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 70	(1999) National Electrical Code
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 0.1 degree F.

1.2.8.1 Space Temperature

Space temperature with a range of 50 to 85 degrees F plus or minus 0.75 degree F for conditioned space; 30 to 130 degrees F plus or minus 1 degree F for unconditioned space.

1.2.8.2 Duct Temperature

Duct temperature with a range of 40 to 140 degrees F plus or minus 2 degrees F.

1.2.8.3 Outside Air Temperature

Outside air (OA) temperature with a range of minus 30 to plus 130 degrees F plus or minus 2 degrees F; with a subrange of 30 to 100 degrees F plus or minus 1 degree F.

1.2.8.4 Water Temperature

Water temperature with a range of 30 to 100 degrees F plus or minus 0.75 degree F; the range of 100 to 250 degrees F plus or minus 2 degrees F; and water temperatures for the purpose of performing Btu calculations using differential temperatures to plus or minus 0.5 degree F using matched sensors.

1.2.8.5 High Temperature

High temperature with a range of 200 to 500 degrees F plus or minus 2.0 degrees F.

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 psi.)

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 gallons per minute).

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; [_____], [_____]

Drawings shall be on 34 by 22 inch 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 Cv, 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 compressed air station schematic diagram shall show all equipment, including: compressor with motor horsepower and voltage; starter; isolators; manual bypasses; tubing sizes; drain piping and drain traps; reducing valves; dryer; and data on manufacturer's names and model numbers, mounting, access, and clearance requirements. Air Compressor and air dryer data shall include calculations of the air consumption of all current-to-pneumatic transducers and of any other control system devices to be connected to the compressed air station, and the compressed air supply dewpoint temperature at 20 psig. Compressed air station schematic drawings shall be submitted for each compressed air station.

f. 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.

g. 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.

h. 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.

i. 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; [_____], [_____]

[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; [_____], [_____]

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; [_____], [_____]

[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; [_____], [_____]

[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; [_____], [_____]

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.

SD-06 Test Reports

Commissioning Report; [_____], [_____]

[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; [_____], [_____]

[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-07 Certificates

Air Storage Tank; [_____], [_____]

An ASME Air Storage Tank Certificate for each storage tank.

SD-10 Operation and Maintenance Data

Operation Manual; [_____], [_____]
Maintenance and Repair Manual; [_____], [_____]

[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 35 to 120 degrees F and 10 to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 35 to plus 150 degrees F. 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.

2.1.4 Year 2000 Compliance

All equipment and software shall be Year 2000 compliant and shall be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if other information technology properly exchanges date/time data with it.

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 2 inch 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 [pneumatic] [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 [,except that VAV terminal unit actuators may be of the floating type]. 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. Pneumatic actuators shall be rated for 25 psig operating pressure except for high-pressure cylinder-type actuators.

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 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Unless otherwise specified, bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends; bodies for 2 inch valves shall have threaded ends; and bodies for valves 2 to 3 inches shall be of brass, bronze or iron. Bodies for valves 2-1/2 inches and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 to 125 percent of the Cv 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 20 to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator. The rated Cv for butterfly valves shall be the value Cv 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 Cv shall be within 100 to 125 percent of the Cv shown. Valves 4 inches and larger shall be butterfly.

2.5.6 Valves for Hot-Water and Dual Temperature Service

For hot water service below 250 degrees F and dual-temperature service, internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 4 inches and larger shall be butterfly valves.

2.5.7 Valves for Steam Service

Bodies for valves 4 inches and larger shall be iron. Internal valve trim shall be Type 316 stainless steel. Valve Cv shall be not less than shown nor greater than the Cv of the manufacturer's next larger size.

2.5.8 Valves for High-Temperature Hot-Water Service

For high-temperature hot water service above 250 Degrees F, valve bodies shall be rated ANSI Class 300, as specified in ASME B16.34. Valve and actuator combination shall be normally closed. Bodies shall be carbon steel, globe type with welded ends on valves 1 inch and larger. Valves smaller than 1 inch shall have socket-weld ends. Packing shall be virgin polytetrafluoroethylene (PTFE). Internal valve trim shall be Type 316 stainless steel. Valve Cv shall be within 100 to 125 percent of the Cv shown.

2.6 DAMPERS

2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. 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 0.5 inch 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 0.04 inch water gauge at 1,000 feet per minute in the wide-open position. Frames shall not be less than 2 inches 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 20 cfm per square foot at 4 inches water gauge static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 200 degrees F. Dampers shall be rated at not less than 2,000 feet per minute 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 80 cfm square foot at 4 inches water gauge static pressure when closed. Dampers shall be rated at not less than 1,500 feet per minute 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 2000 fpm 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 [500 and 4000] [_____] fpm. Detectors shall be

powered from the [HVAC control panel.] [fire alarm control panel (FACP).] 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 50 to 85 degrees F.

b. Duct temperature, from 40 to 140 degrees F.

c. High-temperature hot-water temperature, from 200 to 500 degrees F.

d. Chilled-water temperature, from 30 to 100 degrees F.

e. Dual-temperature water, from 30 to 240 degrees F.

f. Heating hot-water temperature, from 50 to 250 degrees F.

g. Condenser-water temperature, from 30 to 130 degrees F.

h. Outside-air temperature, from minus 30 to 130 degrees F.

i. Relative humidity, 0 to 100 percent for space and duct high-limit applications.

j. Differential pressure for VAV supply-duct static pressure from 0 to 2.0 inches water gauge.

k. Pitot-tube air-flow measurement station and transmitter, from 0 to 0.1 inch water gauge for flow velocities of 700 to 1200 fpm, 0 to 0.25 inch water gauge for velocities of 700 to 1800 fpm, or 0 to 0.5 inch water gauge for velocities of 700 to 2500 fpm.

l. Electronic air-flow measurement station and transmitter, from 125 to 2500 fpm.

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 0.54 degrees F at 32 degrees F with a temperature coefficient of resistance (TCR) of .00214 ohms/ohm/deg F 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 1.0 degree F 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 25 to 130 degrees F. 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 Electronic Airflow Measurement Stations and Transmitters

2.8.4.1 Stations

Each station shall consist of an array of velocity sensing elements and an air-flow straightener. Air-flow straightener shall be contained in a flanged sheet metal or aluminum casing. The velocity sensing elements shall be of the RTD or thermistor type, producing a temperature compensated output. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published application data of the station manufacturer. The resistance to air flow through the

airflow measurement station shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflows of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus three percent over a range of 125 to 2,500 fpm. In outside air measurement or in low-temperature air delivery applications, the station shall be certified by the manufacturer to be accurate as specified over a temperature range of minus 20 to plus 120 degrees F. In outside air measurement applications,the air flow straightener shall be constructed of 1/8 inch aluminum honeycomb and the depth of the straightener shall not be less than 1.5 inches.

2.8.4.2 Transmitters

Each transmitter shall produce a linear, 4-to-20 mAdc, output corresponding to the required velocity pressure measurement. The transmitter shall be a two-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.8.5 Pitot Tube Airflow Measurement Stations and Transmitters

2.8.5.1 Stations

Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the multiple pitot tube type with averaging manifolds. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published installation instructions of the station manufacturer. The resistance to air flow through the airflow measurement station shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflows of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus three percent over a range of 500 to 2,500 fpm. This device will not be used if the required velocity measurement is below 700 fpm or for outside airflow measurements.

2.8.5.2 Transmitters

Each transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required velocity pressure measurement. Each transmitter shall have a low range differential pressure sensing element. The transmitter shall be a two-wire, loop powered device. Sensing element accuracy shall be plus or minus one percent of full scale, and overall transmitter accuracy shall be plus or minus 0.25 percent of the calibrated measurement.

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, 2 inch 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 10 degrees F 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 5 degrees F. 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 2 degrees F. 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 4 to 8 degrees F 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 5 feet, shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 6 to 16 degrees F. Aquastats shall be of the strap on type, with 10 degrees F fixed differential.

2.9.5 Freezestats

Freezestats shall be manual reset, low temperature safety thermostats, with NO and NC contacts and a 20 foot element which shall respond to the coldest 18 inch 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 4 to 8 degrees F 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. Either separate heating thermostats and separate cooling thermostats or dual element heating cooling thermostats may be provided. Motor speed switches shall be provided for three-speed fan control.

2.9.7.1 Heating Thermostat

Fan-coil heating thermostats shall be provided with fixed heat anticipation and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set maximum of [72] [68] degrees F. Heating thermostats shall have an adjustable range of at least 13 degrees below [72] [68] degrees F.

2.9.7.2 Cooling Thermostat

Fan-coil cooling thermostats shall be provided with fixed cooling anticipation heater and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set minimum of 78 degrees F. Cooling thermostats shall have an adjustable range of at least 7 degrees above 78 degrees F.

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 designed to sense air 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 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

2.10.3 Pneumatic Electric (PE) Switches

Each switch shall have an adjustable setpoint range of 3 to 20 psig with a switching differential adjustable from 2 to 5 psig. The switch action shall be SPDT.

2.10.4 Solenoid-Operated Pneumatic (EP) Valves

Each valve shall have three-port operation: common, normally open, and normally closed. Each valve shall have an outer cast aluminum body and internal parts of brass, bronze, or stainless steel. The air connection shall be a 3/8 inch NPT threaded connection. Valves shall be rated for 50 psig when used in a control system that operates at 25 psig or less, or 150 psig when used in a control system that operates in the range of 25 to 100 psig.

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 9 inch 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 3-1/2 inch (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 2 inch (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 Pneumatic Actuator Gauges

Gauges for indicating signal output to pneumatic actuators shall have an outer scale of 3 to 15 psig in 1 psig graduations.

2.11.2.2 Air Storage Tank and Filter and Dryer Gauge

Gauges for air storage tanks or for use before and after dirt and oil filters or dryers, shall have a scale of 0 to 160 psig with 2 psig graduations.

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 3.5 inch (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 Current to Pneumatic (IP) Transducers

The transducers shall be two-wire current-to-pressure transmitters that convert a 4-to-20 mAdc input signal to a 3 to 15 psig, or a 15 to 3 psig, pneumatic output, with a conversion accuracy of plus or minus two percent of full scale, including linearity and hysteresis. Input impedance shall not exceed 250 ohms. Air consumption shall not be greater than 0.25 scfm.

2.12.3 Joule or Watthour Meters

Watthour meters shall be in accordance with ANSI C12.1 and have pulse initiators for remote monitoring of Watthour 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 Watthour 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

Watthour transducers shall have an accuracy of plus or minus 0.25 percent for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh 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.

2.12.7 Power-Line Conditioners (PLC)

Power line conditioners shall be furnished for each DDC panel. The PLCs shall provide both voltage regulation and noise rejection. The PLCs shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power-line side. The PLCs shall be sized for 125 percent of the actual connected kVA load. Characteristics of the PLC shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus one percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus three percent of nominal voltage. Full correction of load switching disturbances shall be accomplished within five cycles, and 95 percent correction shall be accomplished within two cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

2.13 COMPRESSED AIR STATIONS

2.13.1 Air Compressor Assembly

The air compressor shall be a high pressure compressing unit with electric motor. The compressor shall be equipped with a motor with totally enclosed belt guard, an operating-pressure switch, safety relief valves, gauges, intake filter and intake silencer, and combination type magnetic starter with undervoltage protection and thermal-overload protection for each phase, and shall be supported by a steel base mounted on an air storage tank. The air compressor shall provide the compressed air required for control operation while operating not more than one-third of the time. The air storage tank shall be fabricated for a working pressure of not less than 200 psig, and constructed and certified in accordance with ASME BPVC SEC VIII D1. The tank shall be of sufficient volume so that no more than six compressor starts per hour are required with the starting pressure switch differential set at 20 psig. The tank shall be provided with an automatic condensate drain trap with manual override feature. A second (duplex arrangement) compressor of capacity equal to the primary compressor shall be provided, with interlocked control to provide automatic changeover upon malfunction or failure of either compressor. A manual selector switch shall be provided to index the lead compressor including the automatic changeover.

2.13.2 Compressed Air Station Specialties

2.13.2.1 Refrigerated Dryer, Filters and, Pressure Regulator

A refrigerated dryer shall be provided in the air outlet line of the air storage tank. The dryer shall be of the size required for the full delivery capacity of the compressor. The air shall be dried at a pressure of not less than 70 psig to a temperature not greater than 35 degrees F. The dryer shall be provided with an automatic condensate drain trap with manual override feature. The refrigerant used in the dryer shall be one of the fluorocarbon gases and have an Ozone Depletion Potential of not more than 0.05. A five micron prefilter and coalescing-type 0.03 micron oil removal filter with shut-off valves shall be provided in the dryer discharge. Each filter bowl shall be rated for 150 psig maximum working pressure. A pressure regulator, with high side and low side pressure gauges, and a safety valve shall be provided downstream of the filter. Pressure regulators of the relieving type shall not be used.

2.13.2.2 Flexible Pipe Connections

The flexible pipe connectors shall be designed for 150 psig and 250 degrees F service, and shall be constructed of rubber, tetrafluoroethylene resin, or braided corrosion-resistant steel, bronze, monel, or galvanized steel. The connectors shall be suitable for the service intended and may have threaded or soldered ends. The length of the connectors shall be as recommended by the manufacturer for the service intended.

2.13.2.3 Vibration Isolation Units

The vibration isolation units shall be standard products with published loading ratings, and shall be single rubber-in-shear, double rubber-in-shear, or spring type.

2.13.2.4 Compressed Air Piping

Control air delivered to the system shall conform to ISA S7.0.01. Air lines for pneumatic controls shall be seamless copper tubing or nonmetallic tubing. Air lines shall be concealed except in mechanical rooms and other areas where other tubing and piping is exposed. Air lines in exposed and concealed locations, free standing or enclosed in the conduit or other protective coverings, shall be run parallel to the building lines and shall be adequately supported from the building structure, at least every 6 feet horizontally and every 8 feet vertically. Copper tubing shall be hard-drawn in exposed areas and either hard-drawn or annealed in concealed areas. Only tool-made bends shall be used. Fittings for copper tubing shall be brass or copper solder joint type except at connections to apparatus, where fittings shall be brass compression type. Nonmetallic tubing shall be compounded from polyethylene, meeting the stress crack test of ASTM D 1693. Nonmetallic individual tube polyethylene or multitube instrument tubing bundle shall be classified as flame retardant under UL 94. The polyethylene material shall be rated as self-extinguishing when tested in accordance with ASTM D 635. Nonmetallic tubing shall be run within covered rigid metallic raceway, rigid conduit or electric metallic tubing

except as indicated. Single nonmetallic tubing in a protective sheath, run parallel to the building lines and supported as indicated above, may be used above accessible ceilings and in other concealed but accessible locations. Air lines concealed in walls shall be hard-drawn copper tubing or nonmetallic tubing in rigid conduit. Terminal single lines shall be hard-drawn copper tubing, except when the run is less than 12 inches in length, flexible polyethylene may be used. Nonmetallic tubing will not be used for applications where the tubing could be subjected to a temperature exceeding 130 degrees F. Except in walls and exposed locations, nonmetallic multitube instrument tubing bundle without conduit or metallic raceway protection, may be used where a number of air lines run to the same points, provided the multitube bundle is enclosed in a protective sheath, is run parallel to the building lines and is adequately supported as indicated above. Air lines shall be tested periodically for leaks during installation. Air lines shall be purged of dirt, impurities and moisture before connecting to the control equipment. Fittings for nonmetallic tubing shall be for instrument service and may be brass or acetal resin of the compression or barbed push-on type. Air lines shall be number coded or color coded and keyed to the submittal drawings for future identification and servicing the control system.

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 6 feet 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 6 feet 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 reprogramable 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.

b. Air Distribution Terminal Unit Controls - Pressure Independent: Controls shall consist of a transducer for connection to the velocity-sensing device provided by the terminal unit supplier in the primary air entering the terminal unit, a room temperature sensor, a damper actuator, and an adjustable microprocessor-based controller. [[The room temperature sensor shall have occupant setpoint adjustment and temperature display, timed override of unoccupied mode, and a communication port] [_____].] The controller shall operate the damper for cooling and heating and provide control outputs for duct heating coil if applicable. This controller capability shall allow the sequencing of the damper and the heating coil to maintain conditions in the space.

c. Air Distribution Terminal Unit Controls - Pressure Independent with Recirculating Fan: Controls for pressure-independent boxes with recirculating fans shall consist of a transducer for connection to the velocity-sensing device provided by the terminal unit supplier in the primary air entering the terminal unit, a room temperature sensing element, a damper actuator, an adjustable microprocessor-based terminal unit controller, and a switch to operate the recirculation fan, provided by the terminal unit supplier. [[The room temperature sensor shall have occupant setpoint adjustment and temperature display, timed override of unoccupied mode, and a communication port] [_____].] The controller shall operate the damper for cooling and shall provide outputs for controlling the recirculation fan and duct heating coil in sequence for heating.

d. Air Distribution Terminal Unit Damper Actuator: Air distribution terminal unit damper actuator shall open or close the device to which it is connected within 60 seconds. [[The damper actuator shall utilize spring return to fail to the position shown on loss of power or control signal] [_____].]

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 10 inch active color matrix liquid crystal display, capable of displaying up to 256 colors at a minimum resolution of 640 X 480 pixels, an external VGA monitor port, 32 bit microprocessor operating at a minimum of 100 MHZ. The portable workstation/tester shall have, as a minimum, a 1200 MB hard drive, 16 megabytes of memory, integral pointing device, serial and parallel ports, color VGA video port for an external color monitor, 3.5 inch floppy disk drive, modem, PCMCIA type 3 slot, 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 14 inch VGA color display, capable of displaying up to 256 colors at a minimum resolution of 640 X 480 pixels, 32 bit microprocessor operating at a minimum of 100 MHZ. The central workstation/tester shall have, as a minimum, a 2100 MB hard drive, 32 megabytes of memory, integral pointing device, serial and parallel ports, color VGA video port for an external color monitor, 3.5 inch floppy disk drive, modem, PCMCIA type three slot, rechargeable battery, battery charger, 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 Hot Deck/Cold Deck Temperature Reset Program

The software shall use space, mixed air, and deck temperatures to calculate the hot deck/cold deck temperature setpoints in dual duct and multizone HVAC systems. The program shall select the zones with the greatest heating and cooling requirements; establish the HVAC minimum hot and cold deck temperature differentials required to meet the zone temperatures; modulate valves to maintain deck temperature setpoints; and modulate zone dampers to maintain space temperature setpoints, without exceeding space humidity limits (where shown).

a. Program Inputs:

(1) Space temperature setpoint.

(2) Space humidity limit (where shown).

(3) Mixing box damper position or proportional signal from primary element.

(4) Hot deck temperature.

(5) Cold deck temperature.

(6) Zone temperatures (where shown).

(7) Space RH (where shown).

(8) Minimum space temperature during occupied periods.

(9) Maximum space temperature during occupied periods.

(10) Equipment constraints.

b. Program Outputs:

(1) Hot deck valve actuator control signal.

(2) Cold deck valve actuator control signal.

(3) Zone damper or mixing box actuator control output signal.

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 hot water/steam coil valve position 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) Heating or steam coil valve actuator control signal.
(2) Damper actuator control signal.

2.15.10.11 Air Volume Control Program

The software shall monitor supply and return/exhaust air flow volumes and modulate fan controls to maintain required air flow volumes and/or ratio or fixed differential of supply to return air flows. This program shall be coordinated with the ventilation-recirculation program and the economizer program for damper control and with static pressure control requirements for fan control.

a. Program Inputs

(1) Supply air flow.
(2) Return/exhaust air flow.
(3) Required supply air flow - high and low limits.
(4) Required return/exhaust air flow - high and low limits.
(5) Volume offset or ratio, as appropriate.

b. Program Outputs

(1) Supply fan volume control.
(2) Return/exhaust fan volume control.

2.15.10.12 Air Distribution Unitary Controller Software

Software shall be provided for the management and control of the air distribution terminal units. Software shall allow for operator definition of multiple air distribution terminal units as functional groups which may be treated as a single entity; monitoring, alarming and reporting of terminal unit parameters on an individual or group basis; and remote setpoint adjustment on an individual or group basis.

a. Functions:

(1) Volume control in response to temperature.

(2) Volume flow limits, minimum and maximum.
(3) Occupied and unoccupied operation with associated temperature and volume limits.
(4) Temperature setpoint override.

b. Program Inputs

(1) Space temperature.
(2) Space temperature setpoint.
(3) Space temperature setpoint limits.
(4) Supply airflow volume.
(5) Supply airflow volume high and low limits.

c. Program Outputs

(1) Supply volume control signal.
(2) Auxiliary fan start/stop signal.
(3) Supplemental heat control signal.

2.15.10.13 Chiller Selection Program

Chiller program shall be used for chiller selection as well as control and monitoring of chillers. The software shall select the most efficient chiller or combination of chillers based on chiller operating data to satisfy the cooling load. Based on chiller operating data, energy input vs chilled water output, the chiller with the highest efficiency shall be selected to satisfy the cooling load calculated by prediction software. The program shall calculate equipment electrical energy input based on percent full load, current, or other inputs provided, and equipment nameplate data. The program shall prevent the chiller from going to full load for a predetermined period to allow the system to stabilize, in order to determine the actual cooling load. The program shall follow the chiller manufacturer's startup and shutdown sequence requirements. Interlocks between chilled water pumps, condenser water pumps, and chiller shall be in accordance with the chiller manufacturer's requirements.

a. Program Inputs

(1) Efficiency curves.
(2) Chiller water supply temperatures.
(3) Chiller water return temperatures.
(4) Chiller water flows.
(5) Entering condenser water temperatures.
(6) Leaving condenser water temperatures.
(7) Condenser water flows.
(8) Instantaneous KW to chillers.
(9) Instantaneous KW to chilled water pumps (if variable).
(10) Instantaneous KW to condenser water pumps (if variable).
(11) Instantaneous KW to cooling tower fans (if variable).
(12) Common chilled water supply temperatures.
(13) Common chilled water return temperatures.
(14) Total chilled water flow.
(15) Chilled water pumps status.
(16) Refrigerant pressure, suction and discharge.

(17) Equipment constraints.
(18) Steam flow.

b. Program Outputs

(1) Start/stop signals for chillers (manual or automatic to control panel).
(2) Start/stop signals for chilled water pumps (manual or automatic to control panel).
(3) Start/stop signals for condenser water pumps (manual or automatic to control panel).
(4) Start/stop signals for cooling tower fans (manual or automatic to control panel).
(5) Chilled water supply temperature setpoint control signal.
(6) Chiller efficiency.

2.15.10.14 Absorption Chiller Efficiency and Monitoring Program

Chiller program shall be used for monitoring of chillers and to calculate chiller efficiency. The program shall calculate equipment efficiency based on energy input and output and other inputs provided.

a. Program Inputs

(1) Efficiency curves.
(2) Chiller water supply temperatures.
(3) Chiller water return temperatures.
(4) Chiller water flows.
(5) Entering condenser water temperatures.
(6) Leaving condenser water temperatures.
(7) Condenser water flows.
(8) Instantaneous steam to chillers.
(9) Instantaneous KW to chilled water pumps (if variable).
(10) Instantaneous KW to condenser water pumps (if variable).
(11) Instantaneous KW to cooling tower fans (if variable).
(12) Common chilled water supply temperatures.
(13) Common chilled water return temperatures.
(14) Total chilled water flow.
(15) Chilled water pumps status.
(16) Refrigerant pressure, suction and discharge.
(17) Equipment constraints.
(18) Steam pressure.
(19) Steam flow.

b. Program Outputs

(1) Chilled water supply temperatures setpoint control signal.
(2) Chiller efficiency.

2.15.10.15 Chilled Water Temperature Reset Program

The software shall reset the chilled water temperature supplied by a water chiller. The program shall reset the chilled water temperature upward or downward to meet the required space temperature or humidity setpoints. The

program shall monitor the positions of the chilled water control valves (percent of opening) and space temperatures.

a. Program Input:

(1) Chilled water valve position.
(2) High limit for space dry bulb temperature.
(3) Chiller supply water temperature.
(4) High chilled water operating temperature.
(5) Low chilled water operating temperature.
(6) High limit for space RH.
(7) Equipment constraints.

b. Program Output: Chilled water supply temperature setpoint control signal.

2.15.10.16 Condenser Water Temperature Reset Program

The software shall reset the condenser water temperature from a fixed temperature downward when the OA wet bulb temperature will produce lower condenser water temperature. Program shall be coordinated with the chiller control loop algorithms for chiller supply, return water temperatures and safety interlocks.

a. Program Inputs:

(1) Maximum condenser water operating temperature.
(2) Minimum condenser water operating temperature.
(3) Condenser water supply temperature.
(4) OA dry bulb temperature.
(5) OA RH.
(6) Condenser water cooling equipment thermal approach characteristics.
(7) Equipment constraints.

b. Program Output: Condenser water supply temperature setpoint control signal.

2.15.10.17 Chiller Demand Limit Program

The software shall limit maximum available chiller cooling capacity in fixed steps as shown to limit electrical demand. Each fixed step shall be considered as one point in the demand limiting program. Each chiller demand control step shall be assigned an equipment priority level.

a. Program Inputs:

(1) Chiller percent capacity.
(2) Minimum cooling capacity.
(3) Equipment priority schedules.
(4) Equipment constraints.

b. Program Output

(1) Calculated percent load point.
(2) Control signal to chiller controller/panel, new setpoint (manual or automatic as shown).

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) Fuel flow.
(2) Fuel pressure (natural gas).
(3) Fuel temperature (heated fuel oil).
(4) Flame status.
(5) Flue gas oxygen.
(6) Flue gas temperature.
(7) Make-up or feed water flow.
(8) Furnace draft.
(9) Flue gas carbon monoxide (for boilers over 20 million BTUs).
(10) Hot water flow.
(11) Hot water pressure.
(12) Hot water supply temperature.
(13) Hot water return temperature.
(14) Hot water BTUs.
(15) Steam flow.
(16) Steam pressure.
(17) Steam temperature.
(18) Steam BTUs.
(19) Feedwater temperature.

(20) Boiler drum level.

b. Program Outputs

(1) Boiler enable/disable control signal.
(2) Boiler enable/disable permission to boiler operator for manual control.
(3) Boiler efficiency.

2.15.10.20 Heat Recovery Boiler Efficiency and Monitoring

The software shall remotely monitor and calculate efficiency of heat recovery boiler operation. The program shall monitor inputs and alarm operator if any monitored point exceeds a predetermined value or changes status incorrectly.

a. Program Inputs

(1) Exhaust gas flow (from gas turbine generator) into boiler.
(2) Exhaust gas temperature (from gas turbine generator) into boiler.
(3) Flue gas oxygen.(stack)
(4) Flue gas temperature.(stack)
(5) Make-up flow.
(6) Furnace draft.
(7) Flue gas carbon monoxide (for boilers over 20 million BTUs).
(8) Hot water flow (hot water boilers).
(9) Hot water pressure (hot water boilers).
(10) Hot water supply temperature (hot water boilers).
(11) Hot water return temperature (hot water boilers).
(12) Hot water BTUs (hot water boilers).
(13) Steam flow (steam boilers).
(14) Steam pressure (steam boilers).
(15) Steam BTUs (steam boilers).
(16) Feedwater temperature (steam boilers).
(17) Boiler drum level (steam boilers).
(18) Steam temperature.
(19) Position of diverter valve.

b. Program Output: Heat recovery boiler efficiency

2.15.10.21 Hot Water Distribution Program

The software shall control the hot water distribution temperature to individual building zones. The zone hot water distribution temperature shall be reset downward or upward from a fixed temperature proportionally as a function of OA temperature or other specified independent variable by modulating the respective zone mixing valve. The zone pump shall be stopped when the OA temperature exceeds the specified setpoint. When parallel pumps are used, the software shall alternate pump operation and shall start the standby pump (after a time delay) upon failure of the operating pump.

a. Program Inputs

(1) Zone hot water distribution temperature.
(2) Reset schedule.
(3) OA dry bulb temperature or other specified independent variable.
(4) Maximum zone hot water distribution temperature.
(5) Zone pump status.
(6) Equipment constraints.

b. Program Outputs

(1) Zone mixing valve control.
(2) Zone pump start/stop signal(s).

2.15.10.22 Domestic Hot Water Generator Program

The software shall control the domestic hot water temperature by adjusting the hot water heating control valve.

a. Program Inputs

(1) Domestic hot water temperature.
(2) Domestic hot water temperature setpoint.

b. Program Output: Hot water heating control valve actuator control signal.

2.15.10.23 Lighting Control Program

The software shall turn lights on and off based on the time of day and the day of week, including holidays. The program shall generate additional commands at operator adjustable intervals to assure that lights are off (relay operated zoned lighting only).

a. Program Inputs

(1) Day of week-holiday.

(2) Time of day.

(3) Cooling and heating start-stop schedules.

(4) Equipment status.

(5) Times of day for additional off commands (where applicable).

b. Program Output: On/off signal.

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. [Nonmetallic-sheathed cables or metallic-armored cables may be installed in areas permitted by NFPA 70] [_____] 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 Local Gauges for Actuators

Pneumatic actuators shall have an accessible and visible receiver gauge installed in the tubing lines at the actuator as shown.

3.2.3 Room Instrument Mounting

Room instruments , such as wall mounted thermostats, shall be mounted 60 inches above the floor unless otherwise shown. Temperature setpoint devices shall be recess mounted.

3.2.4 Freezestats

For each 20 square feet 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 1 linear foot per square foot 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 Compressed Air Stations

The air compressor assembly shall be mounted on vibration eliminators, in accordance with ASME BPVC SEC VIII D1 for tank clearance. The air line shall be connected to the tank with a flexible pipe connector. Compressed air station specialties shall be installed with required tubing, including condensate tubing to a floor drain.

3.2.8 Duct Static Pressure Sensing Elements and Transmitters

The duct static pressure sensing element and transmitter sensing point shall be located at 75% to 100% of the distance between the first and last air terminal units.

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.

3.2.10 Tubing

3.2.10.1 Control System Installation

The control system shall be installed so that pneumatic lines are not exposed to outside air temperatures. All tubes and tube bundles exposed to view shall be installed neatly in lines parallel to the lines of the building. Tubing between panels and actuators in mechanical/electrical spaces shall be routed so that the lines are easily traceable.

3.2.10.2 Pneumatic Lines In Mechanical/Electrical Spaces

In mechanical/electrical spaces, pneumatic lines shall be plastic tubing or copper tubing. Horizontal and vertical runs of plastic tubes or soft copper tubes shall be installed in raceways dedicated to tubing. Dedicated raceways and tubing not installed in raceways shall be supported every 6 feet for horizontal runs and every 8 feet for vertical runs.

3.2.10.3 Pneumatic Lines External To Mechanical/Electrical Spaces

Tubing external to mechanical/electrical spaces, when run in plenum ceilings, shall be soft copper with sweat fittings. Tubing not in plenum spaces shall be soft copper with sweat fittings or shall be plastic tubing in raceways dedicated to tubing. Raceways and tubing not in raceways shall be supported every 8 feet.

3.2.10.4 Connection to Liquid and Steam Lines

Tubing for connection of sensing elements and transmitters to liquid and steam lines shall be [copper] [Series 300 stainless steel] with [brass compression] [stainless-steel compression] fittings.

3.2.10.5 Connection to Ductwork

Tubing for connection of sensing elements and transmitters to ductwork shall be plastic tubing.

3.2.10.6 Tubing in Concrete

Tubing in concrete shall be installed in rigid conduit. Tubing in walls containing insulation, fill, or other packing materials shall be installed in raceways dedicated to tubing.

3.2.10.7 Final Connection to Actuators

Final connections to actuators shall be plastic tubing 12 inches long and unsupported at the actuator.

3.3 CONTROL SEQUENCES OF OPERATION

3.3.1 General Requirements - HVAC Systems

These requirements shall apply to all primary HVAC systems unless modified herein. The sequences describe the actions of the control system for one

direction of change in the HVAC process analog variable, such as temperature, humidity or pressure. The reverse sequence shall occur when the direction of change is reversed.

3.3.1.1 Supply Fan Operating

HVAC system outside air, return air, and relief air dampers shall function as described for specific modes of operation [unless control of the dampers is assumed by the fire and smoke control system. Smoke dampers shall open before fans are allowed to start.] [Interlocked exhaust fans shall be stopped in the unoccupied and ventilation delay modes and their dampers shall be closed. Interlocked exhaust fans shall run in the occupied mode, and their dampers shall open.] Cooling coil control valves and cooling coil circulating pumps shall function as described for the specific modes of operation [unless their control is assumed by the freeze protection system.] Heating coil valves shall be under control.

3.3.1.2 Supply Fan Not Operating

When an HVAC system is stopped, [all interlocked fans shall stop,] [the smoke dampers shall close,] the outside air and relief air dampers shall close, the return air damper shall open, all stages of direct-expansion cooling shall stop, the system shall pump down if it has a pump down cycle, humidification shall stop, and cooling coil valves for coils located indoors shall close to the coil. Cooling coil valves of units located outdoors shall open to the coil. Heating coil valves shall remain under control.

3.3.1.3 Hydronic Heating - Distribution Pump Operating

Hydronic heat-exchanger valves shall be under control.

3.3.1.4 Hydronic Heating - Distribution Pump Not Operating

Hydronic heat-exchanger valves shall close.

3.3.2 Perimeter Radiation Control Sequence

All Modes - A room thermostat, located as shown, shall operate a control valve to maintain the setpoint as shown.

3.3.3 Unit Heater and Cabinet Unit Heater

All Modes - A wall-mounted thermostat with an "AUTO-OFF" switch located as shown, shall cycle the fan to maintain its setpoint as shown when the switch is in the "AUTO" position. When the switch is in the "OFF" position, the fan shall be stopped.

3.3.4 Gas-Fired Infrared Heater

A microprocessor-based room thermostat with "AUTO-OFF" switch, located as shown, shall control the infrared heater. Auto Mode - When the switch is in the "AUTO" position, the thermostat shall cycle the infrared heater to maintain the day and night setpoints. Programmed occupied times shall be

considered "day" and programmed unoccupied times shall be considered "night." Off Mode - When the switch is in the "OFF" position, the infrared heater shall be off.

3.3.5 All-Air Small Package Unitary System

A microprocessor-based room thermostat, located as shown, with "HEAT-OFF-COOL" and "AUTO-ON" switches shall control the system. Heating Mode - Cooling unit shall be off, and heating shall be active. The thermostat shall operate the condensing unit and system fan to maintain the day and night setpoints as shown. Programmed occupied times shall be considered "day" and programmed unoccupied times shall be considered "night." Cooling Mode - Heating unit shall be off. During the day the thermostat shall operate the condensing units and system fan to maintain the setpoint. The condensing unit shall be off at night. Off Mode - The system shall be off. On Mode - The system fan shall run continuously. Auto Mode - The system fan shall operate whenever heating or cooling is required.

3.3.6 Dual Temperature Fan-Coil Unit

All Modes - A wall-mounted thermostat, located as shown, shall cycle the fan to maintain the setpoint as shown. When the fan is on, a 3-way valve shall open to the coil. When the fan is off, the 3-way valve shall bypass the coil. An aquastat shall switch the wall-mounted thermostat action from heating mode to cooling mode whenever the hydronic dual-temperature medium is below the setpoint.

3.3.7 Central Plant Hydronic Heating with Steam/Hot Water Converter

3.3.7.1 All Modes

The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop pump [_____] at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature as shown. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic heating supply line and the DDC system output shall modulate the converter steam control valve to maintain the reset schedule setpoint in the hydronic heating supply line.

3.3.7.2 Occupied Mode

When the system time schedule places the system in the occupied mode, a space temperature sensing element and transmitter located as shown shall signal the DDC system, which shall maintain the space temperature setpoint by modulating the secondary hydronic system zone valve.

3.3.7.3 Unoccupied Mode

When the system is in the unoccupied mode, the space temperature setpoint shall be as shown.

3.3.8 Single Building Hydronic Heating with Hot Water Boiler

3.3.8.1 All Modes

The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop distribution pump [_____][, boiler pump [_____],] and boiler [_____] at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature as shown. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic heating supply line and the DDC system output shall modulate the hydronic heating system control valve to maintain the reset schedule setpoint in the hydronic heating supply line.

3.3.8.2 Occupied Mode

When the system time schedule places the system in the occupied mode, a space temperature sensing element and transmitter located as shown shall signal the DDC system, which shall maintain the space temperature setpoint shown by modulating the secondary hydronic system zone valve.

3.3.8.3 Unoccupied Mode

When the system is in the unoccupied mode, the space temperature setpoint shall be as shown.

3.3.9 Central Plant High-Temperature Hot-Water Hydronic Heating

3.3.9.1 All Modes

The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop pump [_____] at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature as shown. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic heating supply line and the DDC system output shall modulate the converter high temperature hot water control valve to maintain the reset schedule setpoint in the hydronic heating supply line.

3.3.9.2 Occupied Mode

When the system time schedule places the system in the occupied mode, a space temperature sensing element and transmitter located as shown shall signal the DDC system, which shall maintain the space temperature setpoint as shown by modulating the secondary hydronic system zone valve.

3.3.9.3 Unoccupied Mode

When the system is in the unoccupied mode, the space temperature setpoint shall be as shown.

3.3.10 Central Plant Dual-Temperature Hydronic

Heating and Cooling Modes shall be manually selected.

3.3.10.1 Heating Mode

When the heating mode is selected, the system changeover valves shall close to the central plant chilled water flow and shall open to flow through the converter, and pump [_____] shall be under control of the DDC system. The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop pump [_____] at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic heating supply line and the DDC system output shall modulate the converter's steam control valve to maintain the reset schedule setpoint in the hydronic heating supply line.

3.3.10.2 Cooling Mode

When the cooling mode is selected, the converter steam valve shall be closed. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the system return. The DDC system shall continue to operate pump [_____] to circulate water through the system. When the system return water temperature drops below the setpoint shown, the DDC system shall allow the changeover valves to close to flow through the converter and to open to the central plant chilled water flow, and place the control of pump [_____] under control of the system time schedule. During the occupied mode, pump [_____] shall operate continuously. In the unoccupied mode, pump [_____] shall stop.

3.3.11 Central Plant High-Temperature Hot Water Dual-Temperature Hydronic

Heating and cooling modes shall be manually selected.

3.3.11.1 Heating Mode

When the heating mode is selected, the system changeover valves shall close to the central plant chilled water flow and shall open to flow through the converter, and pump [_____] shall be under control of the DDC system. The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop pump [_____] at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature as shown. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic heating supply line and the DDC system output shall modulate the converter's high-temperature hot-water control valve to maintain the reset schedule setpoint in the hydronic heating supply line.

3.3.11.2 Cooling Mode

When the cooling mode is selected, the converter high-temperature hot-water control valve shall be closed. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the system return as shown. The DDC system shall continue to operate pump [_____] to circulate water through the system. When the system return water temperature drops below the setpoint shown, the DDC system shall allow the changeover valves to close to flow through the converter and to open to the central plant chilled water flow, and place the control of pump [_____] under control of the system time schedule. During the occupied mode, pump [_____] shall operate continuously. In the unoccupied mode, pump [_____] shall stop.

3.3.12 Single Building Dual-Temperature Hydronic

Heating and cooling modes shall be manually selected.

3.3.12.1 Heating Mode

When the heating mode is selected, chiller [_____] shall be stopped. Distribution pump [_____] shall continue to operate until the expiration of a time delay as recommended by the chiller manufacturer. At the expiration of the time delay, the system changeover valves shall close to flow through the chiller and shall open to flow through the boiler, and distribution pump [_____] shall be under control of the DDC system. The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop the distribution pump [_____][, the boiler pump [_____]], and the boiler [_____] at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature as shown. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic supply line and the DDC system output shall modulate the hydronic heating system control valve to maintain the reset schedule setpoint in the hydronic heating supply line.

3.3.12.2 Cooling Mode

When the cooling mode is selected, the boiler [_____] [and the boiler pump [_____]] shall be stopped. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the system supply as shown. The DDC system shall continue to operate the distribution pump [_____] to circulate water through the system with the boiler shut off. When the system supply water temperature drops below the setpoint shown, the DDC system shall allow the changeover valves to close to flow through the boiler and to open to flow through the chiller, and shall place the chiller and the distribution pump [_____] under control of the system time schedule. During the occupied mode, the distribution pump [_____] shall operate continuously and chiller [_____] shall be permitted to operate. When the control system is in the unoccupied mode, chiller [_____] shall shut down. Distribution pump [_____] shall continue to operate until the expiration of the time delay.

3.3.13 Heating and Ventilating Unit

3.3.13.1 Occupied, Unoccupied, and Ventilation Delay Operating Modes

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.13.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall be under space temperature and economizer control.

b. Unoccupied and Ventilation Delay Modes - The dampers shall return to their normal positions.

3.3.13.3 Supply Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints as shown.

3.3.13.4 Filter

The DDC panel shall monitor the differential pressure switch across the filter and shall provide an alarm when the pressure drop exceeds the setpoint.

3.3.13.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.13.6 Space Temperature Control

A space temperature sensing element and transmitter operating through the DDC system shall first gradually shut off the heating coil valve. After the heating coil valve is fully closed, the DDC system shall then gradually operate the outside air damper to admit outside air beyond the minimum quantity to maintain the setpoint as shown.

3.3.13.7 Emergency Fan Shutdown

All Modes - Smoke Detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at

either location. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.14 Multizone with Return Fan

3.3.14.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.14.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall [be under mixed air temperature and economizer control.] [open to their minimum position.]

b. Unoccupied Mode - The dampers shall return to their normal positions as shown.

c. Ventilation Delay Mode - The dampers shall return to their normal positions as shown, [except when under economizer control] [_____].

3.3.14.3 Supply Fan and Return Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] and return fan [_____] shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan and the return fan shall cycle according to the night setback schedule. The fans shall start and stop at the setpoints.

3.3.14.4 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint as shown.

3.3.14.5 Hot-Deck Heating Coil

All Modes - The DDC system shall modulate the control valve from the signal of a temperature sensing element and transmitter located in the discharge air of the coil to maintain the setpoint. A temperature sensing element and transmitter in the outside air intake shall reset the hot-deck temperature setpoint with respect to the outside air temperature signal in a linear schedule as shown.

3.3.14.6 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply and

return fans, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.14.7 Cold-Deck Coil

a. Occupied and Ventilation Delay Modes - The control valve shall be modulated by the DDC system from the signal of a temperature sensing element and transmitter located in the coil discharge air to maintain the setpoint as shown.

b. Unoccupied Mode - The DDC system shall close the cooling coil control valve.

3.3.14.8 Economizer Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. The DDC system shall perform switch over between outside air economizer control mode and minimum outside air mode. Until the outside air temperature rises above the setpoint, the DDC system shall hold the system in the minimum outside air mode. When the outside air temperature rises above the setpoint, the DDC system shall place the AHU in the economizer mode or in the minimum outside air mode as determined by a comparison of the outside air and return air temperatures in accordance with the differential temperature setpoints as shown. When the outside air temperature is low with respect to the return air temperature, the AHU shall be in the economizer mode. When the DDC system places the control system in the minimum outside air mode, the outside air damper shall be open to the minimum outdoor air setting.

3.3.14.9 Mixed Air Temperature Control

When the DDC system places the system in the economizer mode, it shall modulate the dampers from the signal of a temperature sensing element and transmitter in the mixed air stream to maintain the setpoint as shown.

3.3.14.10 Zone Damper Control

All Modes - A space temperature sensor for each zone shall signal the DDC system to gradually operate the zone mixing damper to heat and cool its respective zone by mixing cold-deck air and hot-deck air to maintain the setpoint. On a rise in space temperature, the hot-deck damper shall gradually close, and the cold-deck damper shall gradually open.

3.3.14.11 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and the return fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan and the return fan shall require manual reset at the smoke detectors.

3.3.15 Dual-Duct Multizone with Return Fan

3.3.15.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.15.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall [be under mixed air temperature and economizer control.] [open to their minimum position.]

b. Unoccupied Mode - The dampers shall return to their normal positions as shown.

c. Ventilation Delay Mode - The dampers shall return to their normal positions as shown, [except when under economizer control] [_____].

3.3.15.3 Supply Fan and Return Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] and return fan [_____] shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan and the return fan shall cycle according to the night setback schedule. The fans shall start and stop at the setpoints as shown.

3.3.15.4 Filter

A differential pressure switch across the filter shall initiate the filter alarm when the pressure drop across the filter reaches the setpoint as shown.

3.3.15.5 Hot-Deck Heating Coil

All Modes - The DDC system shall modulate the control valve from the signal of a temperature sensing element and transmitter located in the discharge air of the coil to maintain the setpoint. A temperature sensing element and transmitter in the outside air intake shall reset the hot-deck temperature setpoint with respect to the outside air temperature signal in a linear schedule as shown.

3.3.15.6 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply and return fans, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm

if the temperature drops below the freezestat's setpoint as shown. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.15.7 Cold-Deck Cooling Coil

a. Occupied and Ventilation Delay Modes - The control valve shall be modulated by the DDC system from the signal of a temperature sensing element and transmitter in the coil discharge air to maintain the setpoint as shown.

b. Unoccupied Mode - The cooling coil control valve shall be closed.

3.3.15.8 Economizer Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. The DDC system shall perform switchover between outside air economizer control mode and minimum outside air mode. Until the outside air temperature rises above the setpoint, the DDC system shall hold the system in the minimum outside air mode. When the outside air temperature rises above the setpoint, the DDC system shall place the AHU in the economizer mode or in the minimum outside air mode, as determined by a comparison of the outside air and return air temperatures in accordance with the differential temperature setpoints. When the outside air temperature is low with respect to the return air temperature, the AHU shall be in the economizer mode. When the DDC system places the control system in the minimum outside air mode, the outside air damper shall be open to the minimum outdoor air setting.

3.3.15.9 Mixed Air Temperature Control

When the DDC system places the AHU in the economizer mode, it shall modulate the dampers from the signal of a temperature sensing element and transmitter in the mixed air stream to maintain the setpoint as shown.

3.3.15.10 Dual-Duct Terminal Box

All Modes - A space temperature sensor for each zone shall signal the DDC system to gradually operate the control dampers of the dual-duct box to heat and cool its respective zone by mixing cold-duct air and hot-duct air to maintain the setpoint as shown. On a rise in space temperature, the hot-duct damper shall gradually close, and the cold-duct damper shall gradually open.

3.3.15.11 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and the return fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan and the return fan shall require manual reset at the smoke detectors.

3.3.16 Bypass Multizone with Return Fan

3.3.16.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied-mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.16.2 Outside Air, Return Air, and Relief air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall be under mixed air temperature and economizer control.

b. Unoccupied Mode - The dampers shall return to their normal positions as shown.

c. Ventilation Delay Mode - The dampers shall return to their normal positions as shown, except when under economizer control.

3.3.16.3 Supply Fan and Return Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] and return fan [_____] shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan and the return fan shall cycle according to the night setback schedule. The fans shall start and stop at the setpoints as shown.

3.3.16.4 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint as shown.

3.3.16.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply and return fans, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.16.6 Cold Deck Coil

a. Occupied and Ventilation Delay Modes - The control valve shall be modulated by the DDC system from the signal of a temperature sensing element and transmitter located in the coil discharge air to maintain the setpoint as shown.

b. Unoccupied Mode - The DDC system shall close the cooling coil control valve.

3.3.16.7 Economizer Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. The DDC system shall perform switchover between outside air economizer control mode and minimum outside air mode. Until the return air temperature rises above the setpoint, the DDC system shall hold the system in the minimum outside air mode. When the return air temperature rises above the setpoint, the DDC system shall place the AHU in the economizer mode or in the minimum outside air mode, as determined by a comparison of the outside air and return air temperatures in accordance with the differential temperature setpoints. When the outside air temperature is low with respect to the return air temperature, the AHU shall be in the economizer mode. When the DDC system places the control system in the minimum outside air mode, the outside air damper shall be open to the minimum outdoor air setting.

3.3.16.8 Mixed Air Temperature Control

When the DDC system places the system in the economizer mode, it shall modulate the dampers from the signal of a temperature sensing element and transmitter in the mixed air stream to maintain the setpoint as shown.

3.3.16.9 Zone Control

All Modes - A space temperature sensor for each zone shall signal the DDC system to gradually operate the zone mixing damper and heating coil to heat and cool its respective zone by mixing cold-deck air and bypass-deck air to maintain the setpoint as shown. On a rise in space temperature the heating coil valve shall gradually close and after a deadband as shown, the bypass damper shall gradually close, and the cold deck damper shall gradually open.

3.3.16.10 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and the return fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan and the return fan shall require manual reset at the smoke detectors.

3.3.17 Variable Air Volume Control Sequence without Return Fan

3.3.17.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. During ventilation delay mode, the dampers shall remain in their normal positions as shown, except when under economizer control. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall place the minimum outside air damper under minimum outside air flow control and shall place the economizer outside air, return air, and relief air dampers under economizer control and mixed air temperature. At the

time shown, the DDC system shall place the control system in the unoccupied mode of operation and all dampers shall return to their normal positions as shown.

3.3.17.2 Supply Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] shall start, and operate continuously.

b. Unoccupied Mode - The supply fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints as shown.

3.3.17.3 Supply Duct Pressurization Control

When the supply fan starts, the DDC system shall modulate the inlet vanes from the signal of a static pressure sensing element and transmitter to maintain the setpoint as shown. A high limit static pressure switch in the fan discharge shall stop the supply fan and initiate a high static alarm when the static pressure exceeds the setpoint. When the fan is off, the inlet vanes shall be closed.

3.3.17.4 Filters

A differential pressure switch across each filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint as shown.

3.3.17.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint as shown. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.17.6 Cooling Coil

a. Occupied and Ventilation Delay Modes - The cooling coil control valve shall be modulated by the DDC system from the signal of a temperature sensing element and transmitter located in the coil discharge air to maintain the setpoint as shown.

b. Unoccupied Mode - The cooling coil control valve shall remain closed.

3.3.17.7 Minimum Outside Air Flow Control

a. Occupied Mode - The minimum outside air damper shall be modulated to maintain the minimum outside air flow at setpoint, as sensed by an air flow measurement station located in the minimum outside air duct.

b. Unoccupied and Ventilation Delay Modes - The minimum outside air

damper shall remain closed.

3.3.17.8 Economizer and Mixed Air Temperature Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. When the return air temperature is above the economizer setpoint, and the outside air temperature is sufficiently below the return air temperature to be effective for cooling, the DDC system shall place the AHU in the economizer mode by modulating the economizer outside air, relief air, and the return air dampers to maintain the mixed air temperature at setpoint. As the economizer outside air and relief air dampers open, the return air damper closes. When the system is not in economizer mode, the economizer outside air and relief air dampers shall remain closed and the return air damper shall remain open.

3.3.17.9 Pressure Independent Terminal VAV Box with Velocity Controller

All Modes - The control damper of the VAV box shall modulate in response to the signal from a flow sensing element at the discharge or inlet of the VAV box to a microprocessor based VAV box velocity controller. The velocity controller shall control the box damper from the minimum flow position to the full flow position from the signal of a space temperature sensing element located as shown. When the space temperature decreases, the damper shall gradually close to the minimum flow position to maintain the cooling setpoint as shown. When the space temperature calls for heating after the minimum flow position is reached, control shall then pass through a temperature dead band as shown. When the space temperature has dropped through the dead band, the duct heater coil shall be gradually controlled to maintain the heating setpoint as shown.

3.3.17.10 Fan Powered Terminal VAV Box

a. Series Fan Powered Terminal Box. All Modes - The VAV box fan shall be energized from an upstream duct pressure switch confirming HVAC system fan operation. A space temperature sensing element, located as shown, acting through a microprocessor based VAV box controller, shall modulate the supply air control damper, mixing the supply air and recirculating room air to provide a constant volume of air to the space to maintain the cooling set point as shown until the supply air damper closes to minimum supply air flow. When the space temperature calls for heat after the supply air damper is closed to minimum flow and the VAV box is in maximum recirculation, control shall then pass through the temperature dead band. When the space temperature has dropped through the temperature dead band, the duct heater coil shall be gradually controlled to maintain the heating setpoint.

b. Parallel Fan Powered Terminal VAV Box. All Modes - A space temperature sensing element, located as shown, acting through a microprocessor based VAV box controller, shall modulate the supply air control damper to maintain the cooling setpoint as shown until the supply air damper closes to minimum supply air flow. When the space temperature calls for heat after the supply air damper is closed to minimum flow, control shall then pass through the temperature deadband, and the VAV box

fan shall be energized. When the space temperature has dropped through a second temperature deadband, the duct heater coil shall be gradually controlled to maintain the heating setpoint.

3.3.17.11 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.18 Variable Air Volume Control Sequence with Return Fan

3.3.18.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. During ventilation delay mode, the dampers shall remain in their normal positions as shown, except when under economizer control. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall place the minimum outside air damper under minimum outside air flow control and shall place the economizer outside air, return air, and relief air dampers under economizer and mixed air temperature control. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation and dampers shall return to their normal positions as shown.

3.3.18.2 Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan and return fan shall operate continuously.

b. Unoccupied Mode - The supply fan and the return fan shall cycle according to the night setback schedule. The fans shall start and stop at the setpoints as shown.

3.3.18.3 Supply Duct Pressurization Control

When the supply fan starts, the DDC system shall modulate the inlet vanes from the signal of a static pressure sensing element and transmitter to maintain the setpoint as shown. A high limit static pressure switch in the fan discharge shall stop the supply fan and the return fan and initiate a high static alarm when the static pressure exceeds the setpoint. When the fans are off, the inlet vanes shall be closed.

3.3.18.4 Return Fan Volume Control

When the return fan starts, the DDC system shall modulate the return fan inlet vanes from the signals of an air flow measurement station and transmitter in the return air ductwork, in combination with an air flow measurement station and transmitter in the supply air ductwork, to maintain a constant difference between supply air and return air flow rates as shown.

3.3.18.5 Filters

A differential pressure switch across each filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint as shown.

3.3.18.6 Freeze Protection

A freezestat, located as shown, shall stop the supply and return fans, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint as shown. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.18.7 Cooling Coil Control

a. Occupied and Ventilation Delay Modes - The cooling coil control valve shall be modulated by the DDC system from the signal of a temperature sensing element and transmitter located in the coil discharge air to maintain the setpoint as shown.

b. Unoccupied Mode - The cooling coil control valve shall remain closed.

3.3.18.8 Minimum Outside Air Flow Control

a. Occupied Mode - The minimum outside air damper shall be modulated to maintain the minimum outside air flow at setpoint, as sensed by an air flow measurement station located in the minimum outside air duct.

b. Unoccupied and Ventilation Delay Modes - The minimum outside air damper shall remain closed.

3.3.18.9 Economizer and Mixed Air Temperature Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. When the return air temperature is above the economizer setpoint, and the outside air temperature is sufficiently below the return air temperature to be effective for cooling, the DDC system shall place the AHU in the economizer mode by modulating the economizer outside air, relief air, and the return air dampers to maintain the mixed air temperature at setpoint. As the economizer outside air and relief air dampers open, the return air damper closes. When the system is not in economizer mode, the economizer outside air and relief air dampers shall remain closed and the return air damper shall remain open.

3.3.18.10 Pressure Independent Terminal VAV Box with Velocity Controller

All Modes - The control damper of the VAV box shall modulate in response to the signal from a flow sensing element at the discharge or inlet of the VAV box to a microprocessor based VAV box velocity controller. The velocity controller shall control the box damper from the minimum flow position to the full flow position from the signal of a space temperature sensing

element located as shown. When the space temperature decreases, the damper shall gradually close to the minimum flow position to maintain the cooling setpoint as shown. When the space temperature calls for heating after the minimum flow position is reached, control shall then pass through a temperature dead band as shown. When the space temperature has dropped through the dead band, the duct heater coil shall be gradually controlled to maintain the heating setpoint as shown.

3.3.18.11 Fan Powered Terminal VAV Box

a. Series Fan Powered Terminal Box. All Modes - The VAV box fan shall be energized from an upstream duct pressure switch confirming HVAC system fan operation. A space temperature sensing element, located as shown, acting through a microprocessor based VAV box controller, shall modulate the supply air control damper, mixing the supply air and recirculating room air to provide a constant volume of air to the space to maintain the cooling set point as shown until the supply air damper closes to minimum supply air flow. When the space temperature calls for heat after the supply air damper is closed to minimum flow and the VAV box is in maximum recirculation, control shall then pass through the temperature dead band. When the space temperature has dropped through the temperature dead band, the duct heater coil shall be gradually controlled to maintain the heating setpoint.

b. Parallel Fan Powered Terminal VAV Box. All Modes - A space temperature sensing element, located as shown, acting through a microprocessor based VAV box controller, shall modulate the supply air control damper to maintain the cooling setpoint as shown until the supply air damper closes to minimum supply air flow. When the space temperature calls for heat after the supply air damper is closed to minimum flow, control shall then pass through the temperature deadband, and the VAV box fan shall be energized. When the space temperature has dropped through a second temperature deadband, the duct heater coil shall be gradually controlled to maintain the heating setpoint.

3.3.18.12 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and the return fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan and the return fan shall require manual reset at the smoke detector.

3.3.19 Single Zone with Hydronic Heating/Cooling Coils No Return Fan

3.3.19.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.19.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall be under space temperature and economizer control.

b. Unoccupied Mode - The dampers shall return to their normal positions.

c. Ventilation Delay Mode - The dampers shall return to their normal positions, except when under economizer control.

3.3.19.3 Supply Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints.

3.3.19.4 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

3.3.19.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.19.6 Hydronic Cooling Coil

a. Occupied and Ventilation Delay Modes - The control valve shall be modulated by the DDC system from the signal of a space temperature sensor.

b. Unoccupied Mode - The DDC system shall close the cooling coil control valve.

3.3.19.7 Economizer Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. The DDC system shall perform switchover between outside air economizer control mode and minimum outside air mode. Until the return air temperature rises above the setpoint, the DDC system shall hold the system in the minimum outside air mode. When the return air temperature rises above the setpoint, the DDC system shall place the AHU in the economizer mode or in the minimum outside air mode, as determined by a comparison of the outside air and return air temperatures in accordance with the differential temperature setpoints. When the outside air

temperature is low with respect to the return air temperature, the AHU shall be in the economizer mode. When the DDC system places the control system in the minimum outside air mode, the outside air damper shall be open to the minimum outdoor air setting.

3.3.19.8 Space Temperature Sequenced Heating and Cooling Control

When the DDC system is in the economizer mode, it shall maintain the setpoint from the signal of a space temperature sensor and transmitter. On a rise in space temperature, the DDC system shall first gradually close the heating coil valve. After passing through a deadband, the DDC system shall gradually operate the outside air damper to admit outside air beyond the minimum quantity and after the outside air damper is fully open the DDC system shall then operate the cooling coil valve to maintain the setpoint. When the DDC system is in the minimum outside air mode, the outside air damper shall be open to the minimum outside air setting. On a rise in space temperature, the DDC system shall first gradually close the heating coil valve. After passing through a deadband, the DDC system shall then gradually open the cooling coil valve to maintain the setpoint.

3.3.19.9 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.20 Single Zone with Dual-Temperature Coil; No Return Fan

3.3.20.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.20.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall be under space temperature and economizer control.

b. Unoccupied Mode - The dampers shall return to their normal positions.

c. Ventilation Delay Mode - The dampers shall return to their normal positions, except when under economizer control.

3.3.20.3 Supply Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints as shown.

3.3.20.4 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint as shown.

3.3.20.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.20.6 Dual-Temperature Coil Changeover Control

The DDC panel shall select the heating and cooling modes based on input from a temperature sensor and transmitter located in the dual-temperature supply. When the dual-temperature supply temperature is above the setpoint, the DDC panel shall operate the dual-temperature coil valve as a heating coil valve in sequence with the outside air, return air, and relief air dampers. When the dual-temperature supply temperature is below the setpoint, the DDC system shall operate the dual-temperature coil valve as a cooling coil valve in sequence with the outside air, return air, and relief air dampers.

3.3.20.7 Economizer Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. The DDC system shall perform switchover between outside air economizer control mode and minimum outside air mode. Until the return air temperature rises above the setpoint, the DDC system shall hold the system in the minimum outside air mode. When the return air temperature rises above the setpoint, the DDC system shall place the AHU in the economizer mode or in the minimum outside air mode, as determined by a comparison of the outside air and return air temperatures in accordance with the differential temperature setpoints. When the outside air temperature is low with respect to the return air temperature, the AHU shall be in the economizer mode. When the DDC system places the control system in the minimum outside air mode, the outside air damper shall be open to the minimum outdoor air setting.

3.3.20.8 Space Temperature Sequenced Heating Control

When the DDC system is in the economizer mode, it shall maintain the setpoint from the signal of a space temperature sensor and transmitter. On

a rise in space temperature, the DDC system shall first gradually close the coil valve. After passing through a deadband, the DDC system shall then gradually operate the outside air damper to admit outside air beyond the minimum quantity to maintain the setpoint as shown. When the DDC system is in the minimum outside air mode, the outside air damper shall be open to the minimum outside air setting. On a rise in space temperature, the DDC system shall gradually close the coil valve to maintain the setpoint as shown.

3.3.20.9 Space Temperature Sequenced Cooling Control

When the DDC system is in the economizer mode, it shall maintain the setpoint from the signal of a space temperature sensor and transmitter. On a rise in space temperature, the DDC system shall first gradually open the outside air damper to admit outside air beyond the minimum quantity. When the outside air damper is fully open, on a further rise in space temperature, the DDC system shall gradually open the coil valve. When the DDC system is in the minimum outside air mode, the outside air damper shall be open to the minimum outside air setting. On a rise in space temperature, the DDC system shall gradually open the coil valve to maintain the setpoint.

3.3.20.10 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.21 Single Zone Control with Humidity Control; No Return Fan

3.3.21.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.21.2 Outside Air Damper

a. Occupied Mode - The outside air damper shall open.

b. Unoccupied and Ventilation Delay Modes - The damper shall close.

3.3.21.3 Supply Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints.

3.3.21.4 Filter

Differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

3.3.21.5 Outside Air Preheat-Coil Control

All Modes - The DDC system shall modulate the control valve from the signal of a temperature sensing element and transmitter in the coil discharge air to maintain the setpoint.

3.3.21.6 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.21.7 Cooling Coil

a. Occupied and Ventilation Delay Modes - The DDC system shall compare the signals of a space temperature sensor/transmitter and space relative humidity sensor/transmitter to operate the cooling coil valve. Based on the highest signal received, the DDC system shall modulate the valve to maintain space temperature or space relative humidity.

b. Unoccupied Mode - The DDC system shall close the cooling coil control valve.

3.3.21.8 Humidity Control

a. Occupied Mode - The DDC system shall accept the signals from a space relative humidity sensor and a duct relative humidity sensor to control the humidifier valve and the cooling coil valve. The DDC system shall gradually open the cooling coil valve in the event that the space relative humidity continues to rise after the humidifier valve is closed. The DDC system shall gradually operate the humidifier valve from the signal of a space relative humidity sensor/transmitter to maintain relative humidity setpoint. The DDC system shall receive a signal from a relative humidity sensor/transmitter in the ductwork downstream of the humidifier and shall limit the relative humidity at that point to a high-limit relative humidity setpoint.

b. Unoccupied and Ventilation Delay Modes - The humidifier valve shall be closed.

3.3.21.9 Constant Temperature Hydronic Heating Control

All Modes - The DDC system shall accept a signal from a temperature sensing element and transmitter in the heating supply line, and shall modulate the

system control valve to maintain the setpoint.

3.3.21.10 Reheat

All Modes - The DDC system shall gradually close the reheat coil valve on a rise in space temperature to maintain the setpoint.

3.3.21.11 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan shall require manual reset at the smoke detector.

3.3.22 Single Zone Hydronic Heating and Direct Expansion Cooling Coil

3.3.22.1 Occupied, Unoccupied, and Ventilation Delay Modes

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown, the DDC system shall place the control system in the unoccupied mode of operation.

3.3.22.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall be under mixed air temperature and economizer control.

b. Unoccupied Mode - The dampers shall return to their normal positions.

c. Ventilation Delay Mode - The dampers shall return to their normal positions, except when under economizer control.

3.3.22.3 Supply Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan [_____] shall start and shall operate continuously.

b. Unoccupied Mode - The supply fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints shown.

3.3.22.4 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

3.3.22.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan,

cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

3.3.22.6 Direct Expansion Cooling Coil

a. Occupied and Ventilation Delay Modes - The stages of cooling shall be controlled according to the space temperature.

b. Unoccupied Mode - Cooling shall be off.

3.3.22.7 Economizer Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. The DDC system shall perform switchover between outside air economizer control mode and minimum outside air mode. Until the return air temperature rises above the setpoint, the DDC system shall hold the system in the minimum outside air mode. When the return air temperature rises above the setpoint, the DDC system shall place the AHU in the economizer mode or in the minimum outside air mode, as determined by a comparison of the outside air and return air temperatures in accordance with the differential temperature setpoints. When the outside air temperature is low with respect to the return air temperature, the AHU shall be in the economizer mode. When the DDC system places the control system in the minimum outside air mode, the outside air damper shall be open to the minimum outdoor air setting.

3.3.22.8 Space Temperature Sequenced Heating and Cooling Control

When the DDC system is in the economizer mode, it shall maintain the setpoint as shown from the signal of a space temperature sensor and transmitter. On a rise in space temperature, the DDC system shall first gradually close the heating coil valve. After passing through a deadband, the DDC system shall gradually operate the outside air damper to admit outside air beyond the minimum quantity and after the outside air damper is fully open the DDC system shall operate the stages of cooling in sequence. When the DDC system is in the minimum outside air mode, the outside air damper shall be open to the minimum outside air setting. On a rise in space temperature, the DDC system shall first gradually close the heating coil valve. After passing through a deadband, the DDC system shall operate the stages of cooling in sequence.

3.3.22.9 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan shall require manual reset at the smoke detector.

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 2 feet 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 Space Temperature Controlled Perimeter Radiation

The heating medium shall be turned on, and the thermostat temperature setpoint shall be raised. The valve shall open. The thermostat temperature shall be lowered and the valve shall close. The thermostat shall be set at the setpoint shown.

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 Gas-Fired Infrared Heater

Each space thermostat temperature setting shall be turned up so that it makes contact to turn on the infrared heater; it shall be ensured that the heater turns on. Each space thermostat temperature shall be turned down and it shall be ensured that the infrared heater turns off. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.5 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 Central Plant Hydronic Heating with Steam/Hot Water Converter

Installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. Power and main air shall be available where required. The converter valve shall be closed.

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 hydronic 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 positions for all valves shall be verified. 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) A signal shall be applied to simulate that the outside air temperature is above the setpoint. It shall be verified that pump [_____] stops. A signal shall be applied to simulate that the outside air temperature is below the setpoint. It shall be verified that pump [_____] starts.

(3) The two-point calibration accuracy check of the sensing element-to-DDC system readout for the system supply temperature shall be performed. The system 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.

3.4.8 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 Central Plant High Temperature Hot Water Hydronic Heating

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 and that the converter valve is closed.

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. 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 shall be made to setpoints or parameters 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 pump [_____] stops and the high-temperature

hot-water control valve closes. A value shall be entered to simulate that the outside air temperature is below the setpoint as shown. It shall be verified that pump [_____] starts.

(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. A high temperature condition shall be initiated in the hydronic system supply line by lowering the thermostat setting. It shall be verified that the high-temperature hot water shutoff valve closes and an alarm is initiated. The thermostat shall be set at the setting shown, the safety circuit shall be manually reset, and it shall be verified that the shutoff valve opens and a return-to-normal signal is sent.

(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.

3.4.10 Central Plant Dual Temperature Hydronic

Steps for installation shall be 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, and that the converter steam hot water control valve is closed.

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, hydronic system supply and return 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 valves shall be visually verified. 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 shall be made to setpoints or parameters to achieve the outside air temperature schedule.

(2) The control system shall be indexed to the heating mode and it shall be verified that the changeover valves open to flow through the converter and close to flow from central plant chilled water.

(3) The outside air temperature shall be simulated through an operator entered value to be above the setpoint. It shall be verified that pump [_____] stops. A value shall be entered to simulate that the outside air temperature is below the setpoint. It shall be verified that pump [_____] starts.

(4) 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 shall be set for the temperature schedule. 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.

(5) The two-point accuracy check of the sensing element-to-DDC system readout for the hydronic system return temperature shall be performed. The return water temperature setpoint shall be set to the setpoint. The system shall be placed in the unoccupied mode.

(6) The control system shall be indexed to the cooling mode. It shall be verified that the converter control valve closes and that pump [_____] continues to operate until the return water temperature falls below its setpoint. It shall be verified that when the return water temperature falls below the setpoint that the changeover valves close to flow through the converter and open to flow from central plant chilled water and that Pump [_____] stops.

(7) The control system shall be placed in the occupied mode and it shall be verified that pump [_____] starts.

3.4.11 Central Plant High Temperature Hot Water Dual Temperature Hydronic

Steps for installation shall be 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, and that the converter high temperature hot water control valve is closed.

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 hydronic 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 panel. The proper operation of the actuators and positioners for all valves shall be visually verified. 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 shall be made to setpoints or parameters to achieve the outside air temperature schedule.

(2) The control system shall be indexed to the heating mode and it shall be verified that the changeover valves open to flow through the converter and close to flow from central plant chilled water.

(3) The outside air temperature shall be simulated through an operator entered value to be above the setpoint. It shall be verified that pump [_____] stops and the high-temperature hot water shutoff valve closes. A value shall be entered to simulate that the outside air temperature is below the setpoint as shown. It shall be verified that pump [_____] starts.

(4) 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. 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.

(5) The two-point accuracy check of the sensing element-to-DDC system readout for the hydronic system return temperature shall be performed. The return water temperature setpoint shall be set to the setpoint. The control system shall be placed in the unoccupied mode.

(6) The control system shall be indexed to the cooling mode. It shall be verified that the converter control valve closes and that pump [_____] continues to operate until the return water temperature falls below its setpoint. It shall be verified that

when the return water temperature falls below the setpoint, the changeover valves close to flow through the converter and open to flow from central plant chilled water and that Pump [_____] stops.

(7) The control system shall be placed in the occupied mode and it shall be verified that pump [_____] starts.

3.4.12 Single Building Dual Temperature Hydronic

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, hydronic system supply and return temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator, through an operator entered value. The proper operation of the actuators and positioners for all valves shall be visually verified. The signal shall be varied from live zero to full range, and actuator travel from zero stroke to full stroke within the signal range shall be verified. 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 shall be made to setpoints or parameters to achieve the outside air temperature schedule.

(2) The control system shall be indexed to the heating mode and it shall be verified that chiller [_____] is shut down and that distribution pump [_____] continues to operate until the time delay expires. It shall be verified that the changeover valves open to flow through boiler [_____] and close to flow through chiller [_____] upon expiration of the time delay.

(3) The outside air temperature shall be simulated to be above the setpoint through an operator entered value. It shall be verified that distribution pump [_____] stops, boiler [_____] is stopped, [boiler pump [_____] is stopped,] and control of the hydronic heating system control valve is disabled. A value shall be entered to simulate that the outside air temperature is below the setpoint. It shall be verified that distribution pump [_____]

starts, boiler [_____] is started, [boiler pump [_____] is started,] and control of the hydronic heating system control valve is enabled.

(4) 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.

(5) The two-point accuracy check of sensing element-to-DDC system readout for the hydronic system return temperature shall be performed. It shall be verified that the return water temperature setpoint is set to the setpoint. The control system shall be placed in the unoccupied mode.

(6) The control system shall be indexed to the cooling mode. It shall be verified that boiler [_____] shuts down, [boiler pump [_____] shuts down,] and distribution pump [_____] continues to operate until the return water temperature falls below its setpoint. It shall be verified that when the return water temperature falls below its setpoint that the changeover valves close to flow through the boiler [_____] and open to flow through chiller [_____] and distribution pump [_____] stops.

(7) The control system shall be placed in the occupied mode and it shall be verified that distribution pump [_____] starts and chiller operation is enabled.

(8) The control system shall be placed in the unoccupied mode and it shall be verified that chiller [_____] shuts down and distribution pump [_____] continues to operate until the expiration of the time delay and then stops.

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 Multizone Control System with Return Fan

Steps for installation shall be 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; 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 readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air, return air, mixed air, cold-deck, and hot-deck 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 verified. 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 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 fans ready to start, the system shall be placed in the ventilation delay mode and in the occupied mode, and it shall be verified that supply fan [_____] and return fan [_____] start. It shall be verified that the outside air and relief air dampers are closed, and the return air damper is open, by artificially changing the mixed air temperature through operator entered values. It shall be verified that the heating and cooling coil valves are under control, by artificially changing the hot and cold deck temperatures through operator entered values. The system shall be placed out of the ventilation delay mode through an operator entered value and it shall be verified that the outside air, return air, and relief air dampers come under control, by artificially changing the mixed air 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 mixed air 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 mixed air temperatures shall be performed. The temperature setpoint shall be set as shown.

(4) The two-point calibration sensing element-to-DDC system readout accuracy check for the outside air temperature shall be performed. Any necessary software adjustments shall be made to setpoints or parameters to achieve the outside air temperature schedule as shown.

(5) The two-point calibration accuracy check of sensing element-to-DDC system readout for outside air and hot-deck temperatures shall be performed. The hot deck temperature setpoint shall be set for [_____] degrees F at 20-ma input and [_____] degrees F at 4-ma input. The outside air temperature shall be artificially changed through operator entered values. Three values shall be entered simulating outside air temperature changes. The values shall be selected at midrange, lower 1/3 range, and upper 1/3 range of the temperature schedule. It shall be verified that the hot-deck temperature setpoint tracks the schedule. The hot-deck temperature setpoint shall be set for the existing outside air temperature as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(6) The two-point calibration accuracy check of sensing element-to-DDC system readout for the hot-deck temperature shall be performed. The hot-deck temperature setpoint shall be set as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(7) The two-point calibration accuracy check of sensing element-to-DDC system readout for the cold-deck temperature shall be performed. The cold-deck temperature setpoint shall be set as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(8) 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.

(9) 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.

(10) 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.

(11) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, 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. 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.

(12) The temperature setpoint of each zone thermostat shall be raised and it shall be verified that the zone damper closes to the cold-deck and opens to the hot-deck. Each zone thermostat shall be calibrated and set at its setpoint as shown.

3.4.15 Dual-Duct Multizone Control System with Return Fan

Steps for installation shall be 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; 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 readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air, return air, mixed air, cold-deck, and hot-deck 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 verified. 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 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 fans 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 [_____] and return fan [_____] start. It shall be verified that the outside air and relief air dampers are closed, and the return air damper is open, by artificially changing the mixed air temperature through operator entered values. It shall be verified that the heating and cooling coil valves are under control, by artificially changing the hot and cold deck temperatures through operator entered values. The system shall be placed out of the ventilation delay mode through an operator entered value and it shall be verified that the outside air, return air, and relief air dampers come under control, by artificially changing the mixed air 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 mixed air 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 mixed air temperatures shall be performed. The temperature setpoint shall be set as shown.

(4) The two-point calibration sensing element-to-DDC system readout accuracy check for the outside air temperature shall be performed. Any necessary software adjustments shall be made to setpoints or parameters to achieve the outside air temperature schedule as shown.

(5) The two-point calibration accuracy check of sensing element-to-DDC system readout for outside air and hot-deck temperatures shall be performed. The hot-deck temperature setpoint shall be set for [_____] degrees F at 20-ma input and [_____] degrees F at 4-ma input. The outside air temperature shall be artificially changed through operator entered values. Three values shall be entered simulating outside air temperature changes. The values shall be selected at midrange, lower 1/3 range, and upper 1/3 range of the temperature schedule. It shall

be verified that the hot-deck temperature setpoint tracks the schedule. The hot-deck temperature setpoint shall be set for the existing outside air temperature as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(6) The two-point calibration accuracy check of sensing element-to-DDC system readout for the hot-deck temperature shall be performed. The hot-deck temperature setpoint shall be set as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(7) The two-point calibration accuracy check of sensing element-to-DDC system readout for the cold-deck temperature shall be performed. The cold-deck temperature setpoint shall be set as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(8) 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.

(9) 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.

(10) 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.

(11) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, 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. 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.

(12) The setpoint of each zone thermostat shall be raised and it shall be verified that the dual-duct terminal box damper closes to the cold duct and opens to the hot duct. Each zone thermostat shall be calibrated and set at its setpoint as shown.

3.4.16 Bypass Multizone with Return Fan

Steps for installation shall be 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, relief air damper, and cooling coil valve 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 DDC controller display shall be read, 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, mixed air, cold-deck 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 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 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 fans 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 [_____] and return fan [_____] start. It shall be verified that the outside air and relief air dampers are closed, the return air damper is open, and the heating and cooling coil valves are under control, by simulating a change in the temperature of the cooling coil discharge air and the space temperature through operator entered values. 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 mixed air temperature through operator entered values.

(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 mixed air 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 mixed air temperatures shall be performed. The temperature setpoint shall be set as shown.

(4) The two-point calibration accuracy check of sensing element-to-DDC system readout for the cold-deck temperature shall be performed. The cold-deck temperature setpoint shall be set as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(5) 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 temperature 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 at the setpoint as shown.

(6) 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.

(7) 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.

(8) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, 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 signal is changed to a return-to-normal signal.

(9) The setpoint of each room thermostat shall be changed and correct operation of the zone damper and the heating coil valve shall be verified for each zone. Each room thermostat shall be calibrated and set at its setpoint.

3.4.17 Variable Air Volume Control System - Without Return Fan

Steps for installation shall be 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 and relief air dampers are closed, the return air damper is open, and the supply fan inlet vanes and cooling coil valve are closed.

b. Step 2 - Calibration Accuracy Check with HVAC System in 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, mixed air, and the cooling coil discharge temperatures shall be checked. The minimum outside air flow shall be read, using a digital indicating velometer, and the velometer and DDC system display readings logged. The flow should read zero.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuators 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 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 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 through operator entered values. It shall be verified that supply fan [_____] starts. It shall be verified that the outside air dampers and relief damper are closed, the return air damper is open, and the cooling coil valve and inlet vanes are under control, by simulating a change in the fan discharge temperature. The system shall be placed out of the ventilation delay mode, and it shall be verified that the economizer outside air and relief air dampers remain closed, the return air damper remains open, and the minimum outside air damper comes under control.

(2) The two-point calibration accuracy check of sensing element-to-DDC system readout for the minimum outside air flow measurement station shall be performed. Force all VAV box dampers to the full open position, turn all exhaust fans off, manually adjust the supply duct static pressure to achieve the design duct static pressure, and manually adjust the minimum outside air flow to achieve a flow which is approximately 25% less than the desired air flow. Under these conditions, the minimum outside air flow control loop shall be tuned. Confirm stable operation of the minimum outside air flow control loop in response to a process

disturbance.

(3) With supply fan [_____] running, a high static pressure input signal shall be simulated at the device, by pressure input to the differential pressure switch sensing device. HVAC system shutdown shall be verified; it shall be verified that the high static pressure alarm is initiated. The differential pressure switch shall be set at the setpoint. The HVAC system shall be restarted by manual reset, and it shall be verified that the high static pressure alarm returns to normal.

(4) The two-point calibration accuracy check for sensing element-to-DDC system readout for the static pressure in the supply duct shall be performed.

(5) 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 mixed air temperature shall be artificially changed through operator entered values to slightly open the economizer 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 mixed air temperatures shall be performed. The temperature setpoint shall be set as shown.

(6) The two-point calibration accuracy check of sensing element-to-DDC system readout for the fan discharge temperature shall be performed. The setpoint for the fan discharge temperature shall be set as shown. A change shall be simulated in the discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(7) 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 temperature 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 at the setpoint shown.

(8) 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. This shall be performed for each filter.

(9) 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.

(10) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, 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 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.

(11) Velocity setpoints shall be set for minimum and maximum flow and temperature setpoints for the heating/cooling dead band, for each VAV terminal unit. The actions of the controller, the operation of the damper, and the operation of heating shall be verified. It shall be verified that space temperature is maintained.

3.4.18 Variable Air Volume Control System - With Return Fan

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, and that the outside air and relief air dampers are closed, the return air damper is open, and that the supply fan and return/relief fan inlet vanes and cooling coil valve are closed.

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, mixed air, and cooling coil discharge temperatures shall be checked. The minimum outside air flow, supply air flow, and return air flow shall be read, using a digital indicating velometer, and the velometer and DDC system display readings logged. The flows should read zero.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuators through an operator entered value at 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 actuator travel shall be verified from zero stroke to full stroke within the signal range. 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 fans 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 [_____] and return fan [_____] start. It shall be verified that the outside air dampers and relief air damper are closed, the return air damper is open, and the cooling coil valve and inlet vanes are under control, by simulating a change in the fan discharge temperature. The system shall be placed out of the ventilation delay mode, and it shall be verified that the economizer outside air and relief air dampers remain closed, the return air damper remains open, and the minimum outside air damper comes under control.

(2) The two-point calibration accuracy check of sensing element-to-DDC system readout for the minimum outside air flow measurement station shall be performed. Force all VAV box dampers to the full open position, turn all exhaust fans off, manually adjust the supply duct static pressure to achieve the design duct static pressure, manually adjust the output to the return fan to establish the design differential flow difference between the supply and return duct flows, and manually adjust the minimum outside air flow to achieve a flow which is approximately 25% less than the desired air flow. Under these conditions, the minimum outside air flow control loop shall be tuned. Confirm stable operation of the minimum outside air flow control loop in response to a process disturbance.

(3) The starter switch of return fan [_____] shall be turned to the "OFF" position, and the inlet vane damper shall be opened. With supply fan [_____] running, a high static pressure input signal shall be simulated at the device by a pressure input to the sensing device. HVAC system shutdown shall be observed, and it shall be verified that the high static alarm is initiated. The HVAC system shall be restarted by manual reset, and it shall be verified that the high static alarm returns to normal.

(4) The two-point accuracy check of sensing element-to-DDC system readout for the static pressure in the supply duct shall be performed.

(5) Each VAV terminal unit controller's minimum flow and maximum flow setpoints shall be set at the same setting. This will prevent the VAV box damper from modulating under space temperature control and will achieve a constant supply duct system pressure drop. The return fan inlet vane shall be placed under control, and the starter switch shall be turned to the "AUTO" position so that the fan starts. The two-point calibration accuracy check of sensing element-to-DDC system readout for the air flow measurement stations shall be performed. The supply fan inlet vane shall be operated manually to change the supply fan flow, and the control system shall be set to control at [_____] cfm at 4-ma input and [_____] cfm at 20-ma input. The supply fan flow shall be changed to verify that the return flow setpoint tracks the supply fan flow with the proper flow differential.

(6) 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 mixed air temperature shall be artificially changed through operator entered values to slightly open the economizer 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 mixed air temperatures shall be performed. The temperature setpoint shall be set as shown.

(7) The two-point calibration accuracy check of sensing element-to-DDC system readout for the fan discharge temperature shall be performed. The setpoint for the fan discharge temperature shall be set as shown. A change shall be simulated in the discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(8) 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 temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback temperature setpoint and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint.

(9) 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. This shall be performed for each filter.

(10) 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 as shown. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(11) With the HVAC system running, a smoke detector trip input signal shall be simulated at each device. 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 the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and the alarm return-to-normal shall be verified.

(12) For each VAV terminal unit, velocity setpoints shall be set for minimum and maximum flow, and temperature setpoints for the heating/cooling dead band. The actions of the controller, the operation of the damper, and the operation of heating shall be verified. It shall be verified that space temperature is

maintained.

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.

3.4.20 Single Zone with Dual Temperature Coil; 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, 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 shall be checked for outside air, return air, and space temperatures.

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 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 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 dual-temperature coil control valve is under control, by simulating a change in the space temperature. 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 controller output.

(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) Dual-temperature hydronic changeover operation of aquastat shall be simulated. Control system selection of opposite season space temperature control shall be verified by artificially changing the dual-temperature hydronic temperature.

(5) 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 temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback temperature setpoint and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setting as shown.

(6) 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.

(7) 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.

(8) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, 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.

3.4.21 Single Zone with Humidification; 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, and that the outside air damper, humidifier valve and cooling coil valve are closed.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing elements 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, mixed air, and cooling coil discharge temperatures shall be checked. A motor-driven psychrometer shall be used to check the wet-bulb and dry-bulb temperatures of the humidifier discharge air and of the air in the space, and the psychrometer, and DDC system display readings shall be read and logged.

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 actuators travel shall be verified from zero stroke to full stroke within the signal range. 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 damper is closed, and the heating coil, cooling coil, and humidifier valves are under control, by simulating a change in the space humidity and the space temperature. The system shall be placed out of the ventilation delay mode, and it shall be verified that the outside air damper opens.

(2) The two-point calibration accuracy check of sensing element-to-DDC system readout for the preheat coil discharge air temperature shall be performed. The setpoint for the coil discharge air temperature shall be set as shown. A change shall be simulated in the coil discharge air temperature through an operator entered value and it shall be verified that the preheat coil control valve is modulated.

(3) The calibration accuracy check for sensing element-to-DDC system readout for the space temperature shall be performed. The space temperature setpoint shall be set as shown. A change shall be simulated in the space temperature and it shall be verified that the heating coil valve and cooling coil valve are under control.

(4) The calibration accuracy check for sensing element-to-DDC system readout for the space relative humidity shall be performed. An identical calibration accuracy check for the duct relative humidity shall be performed. The space relative humidity and the duct relative humidity setpoints shall be set as shown. A change shall be simulated in the space relative humidity or in the duct relative humidity and it shall be verified that the humidifier valve and cooling coil valve are under control.

(5) The hydronic heating temperature controller "MANUAL/AUTO" station shall be indexed to the "MANUAL" position. The controller output shall be changed to open the converter valve slightly. The 2-point calibration accuracy check for sensing element-to-DDC system readout for the space temperature shall be performed. The temperature setpoint shall be set as shown.

(6) 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 temperature setpoint and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback temperature setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint as shown.

(7) 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.

(8) 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.

(9) With the HVAC system running, a smoke detector trip input signal shall be simulated at each detector, 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.

3.4.22 Single Zone with Hydronic Heating Direct Expansion Cooling

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, the outside air damper and relief air damper are closed, all stages of cooling are off, 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 of 4 ma to 20 ma, 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 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. Example: NC actuators are closed at 4 ma and are open at 20 ma. The signal levels that move the controlled device to its extreme positions shall be logged. The operating points of the sequence shall be set for each stage of cooling and the proper operation of each stage shall be verified.

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 stages of

cooling are under control, by simulating a change in the space temperature. 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 mixed air 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. A change in space temperature shall be simulated and it shall be verified that the heating coil valve and the stages of D/X cooling operate in sequence 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 temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback temperature 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 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 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 [_____] operating staff members 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 [_____] 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 --

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DIVISION 15 - MECHANICAL

SECTION 15995A

COMMISSIONING OF HVAC SYSTEMS

12/01

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SECTION 15995A

COMMISSIONING OF HVAC SYSTEMS
12/01

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

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; [_____], [_____]

Detailed procedures for pre-commissioning checks and functional performance tests, at least 4 weeks prior to the start of pre-commissioning checks.

Test Schedule; G, [_____]

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, [_____]

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 SEQUENCING AND SCHEDULING

The work described in this Section shall begin only after all work required in related Sections, including Section 15950A HEATING, VENTILATING AND AIR

CONDITIONING (HVAC) CONTROL SYSTEMS and Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved.Seismic details shall be in accordance with Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as indicated]

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. In addition, the Government will be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative
U	Using Agency'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 unless an "X" is shown indicating that participation by that individual is not required. 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.

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.

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping

For [_____] Piping System

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Piping complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Piping flushed and cleaned.	___	___	X	___	X	___	___	___
d. Strainers cleaned.	___	___	X	___	X	___	___	___
e. Valves installed as required.	___	___	X	___	X	___	___	___
f. Piping insulated as required.	___	___	X	___	X	___	___	___
g. Thermometers and gauges installed as required.	___	___	X	___	X	___	___	___
h. Verify operation of valves.	___	___	X	___	___	___	___	___
i. Air vents installed as specified.	___	___	X	X	X	___	___	___
j. Flexible connectors installed as specified	__	___	X	X	X	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Hydrostatic test complete.	___	___	X	___	X	___	___	___
b. TAB operation complete.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Ductwork

For Air Handler: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Ductwork complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Ductwork leak test complete.	___	___	X	___	X	___	___	___

NOTE: The first bracketed item d will be used for Army projects, the second for Air Force projects.

[d. Fire dampers, smoke dampers, and access doors installed as required.	___	___	X	___	X	___	___	___]
[d. Fire dampers, smoke dampers, and access doors installed as required with installation of each verified by the specified team members initialing each location on a copy of the as-built drawings.	___	___	X	___	X	___	___	___]
e. Ductwork insulated as required.	___	___	X	___	X	___	___	___
f. Thermometers and gauges installed as required.	___	___	___	___	___	___	___	___
g. Verify open/closed status of dampers.	___	___	X	___	X	___	___	___
h. Verify smoke dampers operation.	___	___	X	___	___	___	___	___
i. Flexible connectors installed as specified	__	___	X	___	X	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB operation complete.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed [and freed to float with adequate movement and seismic restraint] as specified.	___	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed. (Visually verify pan drains completely by pouring a cup of water into drain pan.)	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
[e. Power available to electric heating coil.	__	___	___	X	___	___	___	___]
Coils								
[a. Chilled water piping properly connected.	___	___	X	X	X	___	___	___]
[a. Refrigerant piping properly connected.	___	___	X	X	X	___	___	___]
[b. Chilled water piping pressure tested.	___	___	X	X	X	___	___	___]
[b. Refrigerant piping pressure tested.	___	___	X	X	X	___	___	___]
[c. Hot water piping properly connected.	___	___	X	X	X	___	___	___]

Pre-commissioning Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
[c. Steam and condensate piping properly connected.	___	___	X	X	X	___	___	___]
[d. Hot water piping pressure tested.	___	___	X	X	X	___	___	___]
[d. Steam and condensate piping pressure tested.	___	___	X	X	X	___	___	___]
e. Air vents installed on water coils [with shutoff valves] as specified.	___	___	X	X	X	___	___	___
f. Any damage to coil fins has been repaired	___	___	X	___	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___
c. O.A. dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. O.A. dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Zone dampers/actuators properly installed.	___	___	X	___	___	___	___	___
f. Zone dampers/actuators operable.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	___	___	X	___	X	___	___	___
b. TAB report submitted.	___	___	X	___	X	___	___	___
c. TAB results within +10%/-0% of cfm shown on drawings								
d. TAB results for outside air intake within +10%/-0% of CFM shown on drawings.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	___	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed. (Visually verify drainage by pouring a cup of water into drain pan.)	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
[e. Power available to electric heating coil.	__	___	___	X	X	___	___	___]
Coils								
[a. Chilled water piping properly connected.	___	___	X	X	X	___	___	___]
[a. Refrigerant piping properly connected.	___	___	X	X	X	___	___	___]
[b. Chilled water piping pressure tested.	___	___	X	X	X	___	___	___]
[b. Refrigerant piping pressure tested.	___	___	X	X	X	___	___	___]
[c. Hot water piping properly connected.	___	___	X	X	X	___	___	___]
[c. Steam and condensate piping properly connected.	___	___	X	X	X	___	___	___]

Pre-commissioning Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
[d. Hot water piping pressure tested.	___	___	X	X	X	___	___	___]
[d. Steam and condensate piping pressure tested.	___	___	X	X	X	___	___	___]
[e. Air vents installed on water coils [with shutoff valves] as specified.	___	___	X	X	X	___	___	___]
f. Any damage to coil fins has been repaired.	__	___	X	___	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location, installation and calibration of duct static pressure sensor.	___	___	X	___	___	___	___	___
f. Fan air volume controller operable.	___	___	X	___	___	___	___	___
g. Air handler controls system operational.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	__	___	X	___	___	___	___	___
b. TAB report submitted.	___	___	X	___	X	___	___	___
c. TAB results within +10%/-0% of cfm shown on drawings								
d. TAB results for outside air intake within +10%/-0% of both the minimum and maximum cfms shown on drawings.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - VAV Terminal

For VAV Terminal: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. VAV terminal in place.	___	___	X	X	X	___	___	___
b. VAV terminal ducted.	___	___	X	X	X	___	___	___
c. VAV terminal connected to controls.	___	___	X	X	___	___	___	___
[d. Reheat coil connected to hot water pipe.	___	___	X	___	X	___	___	___]
[e. Electric reheat coil connected to local disconnect.	___	___	___	___	X	___	___	___]
f. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Controls								
a. Cooling only VAV terminal controls set.	___	___	X	X	___	___	___	___
b. Cooling only VAV controls verified.	___	___	X	X	___	___	___	___
c. Reheat VAV terminal controls set.	___	___	X	X	___	___	___	___
d. Reheat terminal/coil controls verified.	___	___	X	X	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Verify terminal maximum air flow set.	___	___	X	___	___	___	___	___
b. Verify terminal minimum air flow set.	___	___	X	___	___	___	___	___
c. TAB operation complete.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - DX Air Cooled Condensing Unit

For Condensing Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation	___	___	X	X	X	___	___	___
b. Refrigerant pipe leak tested.	___	___	X	X	X	___	___	___
c. Refrigerant pipe evacuated and charged in accordance with manufacturer's instructions.	___	___	X	X	X	___	___	___
d. Check condenser fans for proper rotation.	___	___	X	___	X	___	___	___
e. Any damage to coil fins has been repaired.	__	___	X	___	X	___	___	___
f. Manufacturer's required maintenance/ operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls	___	___	___	X	___	___	___	___
Controls								
a. Unit safety/protection devices tested.	___	___	X	X	___	___	___	___
b. Control system and interlocks installed.	___	___	X	X	___	___	___	___
c. Control system and interlocks operational.	__	___	X	X	___	___	___	___

Pre-commissioning Checklist - Pumps

For Pump: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Pumps grouted in place.	___	___	X	X	X	___	___	___
b. Pump vibration isolation devices functional.	___	___	X	X	X	___	___	___
c. Pump/motor coupling alignment verified.	___	___	X	X	X	___	___	___
d. Piping system installed.	___	___	X	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	X	___	___	___
f. Pump not leaking.	___	___	X	X	X	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to pump disconnect.	___	___	___	X	X	___	___	___
b. Pump rotation verified.	___	___	___	X	X	___	___	___
c. Control system interlocks functional.	___	___	___	X	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Pressure/temperature gauges installed.	___	___	X	___	X	___	___	___
b. Piping system cleaned.	___	___	X	X	X	___	___	___
c. Chemical water treatment complete.	___	___	X	X	X	___	___	___
d. Water balance complete.	___	___	X	___	X	___	___	___
e. Water balance with design maximum flow.	___	___	X	___	X	___	___	___
f. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Packaged Air Cooled Chiller

For Chiller: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Chiller properly piped.	___	___	X	___	___	___	___	___
b. Chilled water pipe leak tested.	___	___	X	X	X	___	___	___
c. Verify that refrigerant used complies with specified requirements.	___	___	X	X	X	___	___	___
d. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
e. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Separate power is supplied to electric heating tape.	___	___	___	X	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Factory startup and checkout complete.	___	___	X	X	___	___	___	___
b. Chiller safety/protection devices tested.	___	___	X	X	___	___	___	___
c. Chilled water flow switch installed.	___	___	X	X	___	___	___	___
d. Chilled water flow switch tested.	___	___	X	X	___	___	___	___
e. Chilled water pump interlock installed.	___	___	X	X	X	___	___	___
f. Chilled water pump interlock tested.	___	___	___	X	___	___	___	___

Pre-commissioning Checklist - Centrifugal Chiller

For Chiller: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Chilled water connections properly piped.	___	___	X	___	___	___	___	___
b. Condenser water connections properly piped	___	___	X	___	___	___	___	___
c. Chilled water pipe leak tested.	___	___	X	X	X	___	___	___
d. Condenser water pipe leak tested.	___	___	X	X	X	___	___	___
e. High efficiency purge unit installed and operating as specified.	___	___	X	X	X	___	___	___
f. Refrigerant leak detector installed.	___	___	___	___	___	___	___	___
g. Oxygen sensor installed and tested.	___	___	___	___	___	___	___	___
h. Mechanical room ventilation installed as specified.	___	___	___	___	___	___	___	___
i. Manufacturer's required maintenance clearance provided.	___	___	X	X	___	___	___	___
j. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit starter.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Factory startup and checkout complete.	___	___	X	X	___	___	___	___
b. Chiller safety/protection devices tested.	___	___	___	X	___	___	___	___
c. Chilled water flow switch installed.	___	___	X	X	___	___	___	___
d. Chilled water flow switch tested.	___	___	X	X	___	___	___	___
e. Chilled water pump interlock installed.	___	___	___	X	___	___	___	___

Pre-commissioning Checklist - Centrifugal Chiller

For Chiller: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
f. Chilled water pump interlock tested.	___	___	___	X	___	___	___	___
g. Condenser water flow switch installed.	___	___	X	___	___	___	___	___
h. Condenser water flow switch tested.	___	___	___	X	___	___	___	___
i. Condenser water pump interlock installed.	___	___	___	X	___	___	___	___
j. Condenser water pump interlock tested.	___	___	___	X	___	___	___	___

Pre-commissioning Checklist - Cooling Tower

For Cooling Tower: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Cooling tower in place.	___	___	X	___	___	___	___	___
b. Cooling tower piped.	___	___	X	X	___	___	___	___
c. Cooling tower fan drive adjusted.	___	___	___	___	X	___	___	___
d. Cooling tower makeup water supply piped.	___	___	X	X	___	___	___	___
e. Verify makeup control valve shutoff.	___	___	X	___	X	___	___	___
f. Fan lubricated and blade pitch adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance/ operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to tower disconnect.	___	___	___	X	___	___	___	___
b. Power available to electric sump heater.	___	___	___	X	___	___	___	___
c. Control system interlocks functional.	___	___	___	X	___	___	___	___
d. Motor and fan rotation checked.	___	___	___	X	___	___	___	___
e. Verify that power disconnect is located within sight of the unit is controls.	___	___	___	X	___	___	___	___
Piping								
a. Tower basin is clean and filled.	___	___	X	X	X	___	___	___
b. Condenser water treatment functional.	___	___	X	X	X	___	___	___
c. Water balance with design flow verified.	___	___	X	___	X	___	___	___
d. Water distribution headers balanced.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Hot Water Boiler

For Boiler: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Boiler flue installed.	___	___	X	___	___	___	___	___
b. Boiler hot water piping installed.	___	___	X	___	___	___	___	___
c. Boiler hot water piping tested.	___	___	X	X	___	___	___	___
d. Boiler makeup water piping installed.	___	___	X	___	___	___	___	___
e. Boiler fuel oil piping installed.	___	___	X	X	X	___	___	___
f. Boiler fuel oil piping tested.	___	___	X	X	X	___	___	___
g. Boiler gas piping installed.	___	___	X	X	X	___	___	___
h. Boiler gas piping tested.	___	___	X	X	X	___	___	___
i. Manufacturer's required maintenance clearance provided.	___	___	X	___	___	___	___	___
Startup								
a. Boiler system cleaned and filled with treated water.	___	___	X	___	___	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___	X	___	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___	X	___	___	___	___
d. Boiler water treatment system functional.	___	___	X	X	___	___	___	___
e. Boiler startup and checkout complete.	___	___	X	X	___	___	___	___
f. Combustion efficiency demonstrated.	___	___	X	___	X	___	___	___
Electrical								
a. Verify that power disconnect is located within sight of the unit served.	___	___	___	X	___	___	___	___
Controls								

Pre-commissioning Checklist - Hot Water Boiler

For Boiler: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
a. Hot water pump interlock installed.	___	___	___	X	___	___	___	___
b. Hot water pump interlock tested.	___	___	___	X	___	___	___	___
c. Hot water heating system balanced.	___	___	X	X	___	___	___	___
d. Hot water heating controls operational.	___	___	X	X	___	___	___	___

Pre-commissioning Checklist - Steam Boiler

For Boiler: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Boiler flue installed.	___	___	X	X	X	___	___	___
b. Boiler steam piping installed.	___	___	X	X	X	___	___	___
c. Boiler steam piping tested.	___	___	X	X	X	___	___	___
d. Boiler makeup water piping installed.	___	___	X	___	X	___	___	___
e. Boiler makeup water piping tested.	___	___	X	X	X	___	___	___
f. Boiler fuel oil piping installed.	___	___	X	X	X	___	___	___
g. Boiler fuel oil piping tested.	___	___	X	X	X	___	___	___
h. Boiler gas piping installed.	___	___	X	X	X	___	___	___
i. Boiler gas piping tested.	___	___	X	X	X	___	___	___
j. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Startup								
a. Boiler system cleaned and filled with treated water.	___	___	X	X	X	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___	X	___	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___	X	___	___	___	___
d. Boiler feed water system operational.	___	___	___	X	___	___	___	___
e. Boiler water treatment system functional.	___	___	X	X	X	___	___	___
f. Boiler startup and checkout complete.	___	___	___	X	___	___	___	___
g. All steam traps operational.	___	___	X	X	X	___	___	___
h. All condensate return pumps operational.	___	___	___	___	X	___	___	___
i. Combustion efficiency demonstrated.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Steam Boiler

For Boiler: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Electrical								
a. Verify that power disconnect is located within sight of the unit served.	___	___	___	X	___	___	___	___

Pre-commissioning Checklist - Steam/Hot Water Converter

For Converter: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Converter steam piping installed.	___	___	X	___	X	___	___	___
b. Converter steam piping tested.	___	___	X	X	X	___	___	___
c. Hot water piping installed.	___	___	X	___	___	___	___	___
d. Hot water piping tested.	___	___	X	X	X	___	___	___
e. Makeup water piping installed.	___	___	X	X	X	___	___	___
f. Vacuum breaker installed on shell of shell and tube unit.	___	___	X	X	X	___	___	___
g. Air vent installed as specified.	___	___	X	X	X	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Startup								
a. Hot water system cleaned and filled.	___	___	X	X	X	___	___	___
b. All steam traps operational.	___	___	X	X	X	___	___	___
c. All condensate return pumps operational.	___	___	___	X	___	___	___	___
d. Converter safety/protection devices tested.	___	___	X	X	X	___	___	___
e. Converter startup and checkout complete.	___	___	X	X	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Fan Coil Unit

For Fan Coil Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	___	___	X	X	X	___	___	___
b. Access doors/removable panels are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed.	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Any damage to coil fins has been repaired.	__	___	X	___	X	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
[e. Power available to electric heating coil.	__	___	___	X	X	___	___	___]
Coils								
[a. Dual temperature piping properly connected.	___	___	X	___	___	___	___	___]
[a. Chilled water piping properly connected.	___	___	X	X	X	___	___	___]
[b. Dual temperature piping pressure tested.	___	___	X	___	___	___	___	___]
[b. Chilled water piping pressure tested.	___	___	X	X	X	___	___	___]
[c. Hot water piping properly connected.	___	___	X	___	___	___	___	___]
[d. Hot water piping pressure tested.	___	___	X	___	___	___	___	___]

Pre-commissioning Checklist - Fan Coil Unit

For Fan Coil Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	__	___	X	___	___	___	___	___
b. TAB results +10%/-0% of cfm shown on drawings								
c. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Unit Heater

For Unit Heater: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
[a. Hot water piping properly connected.	___	___	X	___	___	___	___	___]
[a. Steam and condensate piping properly connected.	___	___	X	X	X	___	___	___]
[b. Hot water piping pressure tested.	___	___	X	___	___	___	___	___]
[b. Steam and condensate piping pressure tested.	___	___	X	X	X	___	___	___]
c. Air vent installed on hot water coil with shutoff valve as specified.	___	___	X	X	X	___	___	___
d. Any damage to coil fins has been repaired.	__	___	X	___	X	___	___	___
e. Manufacturer's required maintenance/ operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	X	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
d. Power available to electric heating coil.	___	___	___	X	___	___	___	___
Controls								
a. Control valves properly installed.	___	___	X	___	___	___	___	___
b. Control valves operable.	___	___	X	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Exhaust Fan

For Exhaust Fan: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Fan belt adjusted.	___	___	X	___	X	___	___	___
Electrical								
a. Power available to fan disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control interlocks properly installed.	___	___	___	X	___	___	___	___
b. Control interlocks operable.	___	___	___	X	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB results +10%/-0% to cfm shown on drawings	___	___	X	___	X	___	___	___
b. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Computer Room Unit

For Computer Room Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Unit properly supported.	___	___	X	X	X	___	___	___
b. Access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed and routed to floor drain.	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
[e. Power available to reheat coils.	___	___	___	___	X	___	___	___]
Coils/Humidifier								
[a. Chilled water piping properly connected.	___	___	X	___	___	___	___	___]
[a. Refrigerant piping properly connected.	___	___	X	X	X	___	___	___]
[b. Chilled water piping pressure tested.	___	___	X	X	X	___	___	___]
[b. Refrigerant piping pressure tested.	___	___	X	X	X	___	___	___]
[c. Hot water piping properly connected.	___	___	X	___	___	___	___	___]
[c. Steam piping properly connected.	___	___	X	X	X	___	___	___]
[d. Hot water piping pressure tested.	___	___	X	X	___	___	___	___]

Pre-commissioning Checklist - Computer Room Unit

For Computer Room Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
[d. Steam piping pressure tested.	___	___	X	X	X	___	___	___]
e. Humidifier makeup water connected.	___	___	X	X	X	___	___	___
Controls								
a. Control valves operable.	___	___	X	X	___	___	___	___
b. Unit control system operable and verified.	__	___	___	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	__	___	X	___	X	___	___	___
b. TAB results +10%/-0% cfm shown on drawings.	___	___	X	___	X	___	___	___
c. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - HVAC System Controls

For HVAC System: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. As-built shop drawings submitted.	___	___	X	X	___	___	___	___
b. Layout of control panel matches drawings.	___	___	X	X	___	___	___	___
c. Framed instructions mounted in or near control panel.	___	___	X	X	___	___	___	___
d. Components properly labeled (on inside and outside of panel).	___	___	X	X	___	___	___	___
e. Control components piped and/or wired to each labeled terminal strip.	___	___	X	X	___	___	___	___
f. EMCS connection made to each labeled terminal strip as shown.	___	___	X	X	___	___	___	___
g. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	X	X	___	___	___	___
h. Shielded wiring used on electronic sensors.	__	__	X	X	___	___	___	___
i. Air dryer installed as specified.	___	___	X	X	___	___	___	___
j. Water drain installed as specified.	___	___	X	X	___	___	___	___
Main Power and Control Air								
a. 110 volt AC power available to panel.	___	___	___	X	___	___	___	___
b. 20 psig compressed air available to panel.	___	___	X	X	___	___	___	___
Testing, Commissioning, and Balancing								
a. Testing, Commissioning, and Balancing Report submitted.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Single Zone Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	__	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	__	___	X	___	X	___	___	___
c. Casing undamaged.	__	___	X	X	X	___	___	___
d. Insulation undamaged.	__	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed.	__	___	X	X	X	___	___	___
f. Fan belt adjusted.	__	___	X	___	X	___	___	___
g. Any damage to coil fins has been repaired.	__	__	X	___	X	___	___	___
h. Manufacturer's required maintenance clearance provided.	__	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	__	___	___	X	X	___	___	___
b. Power available to unit control panel.	__	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	__	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	__	X	___	___	___	___
e. Power available to electric heating coil.	__	___	___	X	___	___	___	___
Coils								
[a. Chilled water piping properly connected.	__	___	X	__	___	___	___	___]
[a. Refrigerant piping properly connected.	__	___	X	X	X	___	___	___]
[b. Chilled water piping pressure tested.	__	___	X	X	X	___	___	___]
[b. Refrigerant piping pressure tested.	__	___	X	X	X	___	___	___]
[c. Hot water piping properly connected.	__	___	X	___	___	___	___	___]
[c. Steam and condensate piping properly connected.	___	___	X	X	X	___	__	___]

Pre-commissioning Checklist - Single Zone Air Handling Unit

For Air Handling Unit: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
[d. Hot water piping pressure tested.	___	___	X	X	__	___	___	___]
[d. Steam and condensate piping pressure tested.	___	___	X	X	X	__	___	___]
[e. Air vents installed on water coils [with shutoff valves] as specified.	___	___	X	X	X	__	___	___]
f. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	___	___	X	___	X	___	___	___
b. TAB results +10%/-0% cfm shown on drawings.	___	___	X	___	X	___	___	___
c. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Energy Recovery System

For Energy Recovery System: [_____]

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Recovery system piping installed.	___	___	X	___	X	___	___	___
b. Recovery system piping tested.	___	___	X	X	X	___	___	___
c. Air vent installed as specified.	___	___	X	X	X	___	___	___
d. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Startup								
a. Recovery system piping cleaned and filled.	___	___	X	X	X	___	___	___
b. Converter startup and checkout complete.	___	___	X	X	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Pumps

For Pump: [_____]

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 _____ 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	SYSTEM TEST	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 (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 (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	_____	_____	

Functional Performance Test Checklist - Pumps

For Pump: [_____]

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 Chief 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 _____

Functional Performance Test Checklist - Centrifugal Chiller

For Chiller: [_____]

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. Time of day startup program initiates chiller start: _____

b. Start condenser water pump and establish condenser water flow. Verify chiller condenser water proof-of-flow switch operation. _____

c. Start chilled water pump and establish chilled water flow. Verify chiller chilled water proof-of-flow switch operation. _____

d. Verify control system energizes chiller start sequence. _____

e. Verify chiller senses chilled water temperature above set point and control system activates chiller start. _____

f. Verify functioning of "soft start" sequence. _____

g. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____

h. Restart air handling equipment one minute after chiller shut down. Verify condenser water pump, cooling tower, and chiller restart sequence.

_____

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 Chief 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 _____

Functional Performance Test Checklist - Centrifugal Chiller

For Chiller: [_____]

Functional Performance Test Checklist - Cooling Tower

For Cooling Tower: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of the cooling tower as per specification and the following:

a. Activate cooling tower fan start using control system command. This should first start condenser water pump, establish flow, delay fan start, as specified, to equalize flow in distribution basin and sump. Verify fan start after timed delay. _____

b. After chiller startup, control system should modulate bypass valve and two-speed fan motor to maintain condenser water set point. Verify function of bypass valve under varying loads. _____

c. Verify cooling tower interlock with chiller. _____

d. Verify makeup water float valve is functioning: _____
Activate chemical treatment feed valve, verify makeup of chemical treatment system, pump, and controls: _____

e. Entering water temperature [_____] degrees F
Leaving water temperature: [_____] degrees F
Air volume measured: [_____] cfm
Air volume calculated: [_____] cfm
Entering wet bulb temperature: [_____] degrees F
Measured water flow: [_____] gpm

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 Chief 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 _____

Functional Performance Test Checklist - VAV Terminals

The Contracting officer will select VAV terminals to be spot-checked during the functional performance test. The number of terminals shall not exceed [2] [10] [10 percent].

1. Functional Performance Test: Contractor shall demonstrate operation of selected VAV boxes as per specifications including the following:

a. Cooling only VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

Maximum flow [_____] cfm
Minimum flow [_____] cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting [_____] cfm
Minimum flow setting [_____] cfm

b. Cooling with reheat VAV boxes:

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

Maximum flow [_____] cfm
Minimum flow [_____] cfm

(2) Check damper maximum/minimum flow settings.

Maximum flow setting [_____] cfm
Minimum flow setting [_____] cfm

Reheat coil operation range (full open to full closed) _____

c. Fan powered VAV boxes:

(1) Verify VAV box response to sensor call for heating via set point adjustment. Changes to be cooling setpoint to heating set point and return to cooling set point. _____ Verify cooling damper closes to minimum position, blower fan energizes according to sequence of operation, and upon further drop in space temperature, heating coil activation and deactivation. _____

(2) Check primary air damper maximum/minimum flow settings.

Functional Performance Test Checklist - VAV Terminals
Maximum flow setting [_____] cfm
Minimum flow setting [_____] cfm

(3) Check blower fan flow. [_____] cfm

(4) Verify free operation of fan backdraft damper (insure no primary air is being discharged through the recirculated air register).
_____

(5) Verify that no recirculated air is being induced when box is in full cooling. _____

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 Chief 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 _____

Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]

Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

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] [supply and return fans operating] mode is initiated:

(1) All dampers in normal position [and fan inlet vanes modulate to maintain the required static pressure]. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

(4) VAV fan controller shall "soft-start" fan. _____

(5) Modulate all VAV boxes to minimum air flow and verify that the static pressure does not exceed the design static pressure Class shown. _____

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] [closed]. _____

(4) Chilled water control valve modulating to maintain leaving air temperature set point. _____

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point. _____

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 leaving air temperature set point. _____

Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]

(4) Hot water control valve modulating to maintain leaving air temperature set point. _____

(5) Fan VAV controller receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure 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] [supply and return fans off] mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify the chilled water coil control valve operation by setting all VAV's to maximum and minimum cooling.

	Max cooling	Min cooling
Supply air volume _____ cfm)	_____	_____
Supply air temp. (_____ degrees F)	_____	_____

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 Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Functional Performance Test Checklist - Variable Volume Air Handling Unit

For Air Handling Unit: [_____]
Contractor's Testing, Adjusting and Balancing Representative
_____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: [_____]

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] [supply and return fans operating] mode is initiated:

(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] [closed]. _____

(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. _____

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: [_____]

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] [supply and return fans 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 Chief 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 _____

Functional Performance Test Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

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 and return fans operating mode is initiated:

(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] [closed]. _____

(4) Chilled water control valve modulating to maintain cold deck supply air temperature set point. _____

(5) Hot water control valve modulating to maintain hot deck supply air temperature set point input from outside air temperature controller. _____

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulates 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 cold deck supply air temperature set point. _____

(4) Hot water control valve modulating to maintain hot deck supply air temperature set point input from outside air temperature controller. _____

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

Functional Performance Test Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the supply and return fans off mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify zone damper operation by varying zone thermostat set points 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. _____

i. Index room thermostats to full cooling then to full heating. Measure and record cold deck, hot deck, and supply air temperatures and determine damper leakage for a minimum of 2 zones.

Cold deck temperature _____ degrees F
Hot deck temperature _____ degrees F

Zone _____
Cooling temperature _____ degrees F
Heating temperature _____ degrees F
Damper leakage cooling ____ degrees F
Damper leakage heating ____ degrees

Zone _____
Cooling temperature _____ degrees F
Heating temperature _____ degrees F
Damper leakage cooling ____ degrees F
Damper leakage heating ____ 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.

Functional Performance Test Checklist - Multizone Air Handling Unit

For Air Handling Unit: [_____]

	Signature and Date
Contractor's Chief 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	_____

Functional Performance Test Checklist - Packaged Air Cooled Chiller

For Chiller: [_____]

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	SYSTEM TEST	ACTUAL
Chiller inlet pressure (psig)	_____	_____	_____
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 F
Ambient wet bulb temperature _____ degrees F
Entering chilled water temperature _____ degrees F
Leaving chilled water temperature _____ degrees F

Functional Performance Test Checklist - Packaged Air Cooled Chiller

For Chiller: [_____]

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 Chief 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 _____

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Unit: [_____]

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 to verify condensing unit de-energizes. _____

c. Restart air handling equipment 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 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 Chief Quality Control Representative

_____

Contractor's Mechanical Representative _____

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Unit: [_____]

Contractor's Electrical Representative Representative _____

Contractor's Testing, Adjusting and Balancing _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Hot Water Boiler

For Boiler: [_____]

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	SYSTEM TEST	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 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. _____

Functional Performance Test Checklist - Hot Water Boiler

For Boiler: [_____]

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 Chief 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 _____

Functional Performance Test Checklist - Steam Boiler

For Boiler: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of steam heating 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 steam heating system. Verify control system energizes boiler start sequence. _____

b. Verify boiler senses steam pressure below set point and control system activates boiler start. _____

c. Shut off building heating equipment to remove load on steam heating system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____

d. Verify that water level and makeup water system are operational.
_____

2. Verify boiler inlet/outlet pressure reading, compare to boiler design conditions and manufacturer's performance data.

	DESIGN	SYSTEM TEST	ACTUAL
Boiler inlet water temp (degrees F)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Flue-gas temperature at boiler outlet (degrees F)		_____	_____
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
Ambient temperature _____ degrees F

4. Verify proper operation of boiler safeties. _____

5. Unusual vibration, noise, etc.

_____

_____

6. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement. _____

Functional Performance Test Checklist - Steam Boiler

For Boiler: [_____]

7. 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 Chief 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 _____

Functional Performance Test Checklist - Fan Coil Units

The Contracting Officer will select fan coil units to be spot-checked during the functional performance test. The number of terminals shall not exceed [2] [10] [10 percent].

1. Functional Performance Test: Contractor shall demonstrate operation of selected fan coils as per specifications including the following:

a. Cooling only fan coils:

(1) Verify fan coil unit response to room temperature set point adjustment. Changes to be cooling set point to cooling set point minus 10 degrees and return to cooling set point. _____

(2) Check blower fan air flow.
Check blower fan air flow. _____ cfm

(3) Check cooling coil water flow.
Check cooling coil water flow. _____ gpm

(4) Verify proper operation of cooling water control valve. _____

b. 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.
Check blower fan air flow. _____ cfm

(3) Check cooling coil water flow.
Check cooling coil water flow. _____ cfm

(4) Verify proper operation of cooling water control valve. _____

(5) Check cooling mode inlet air temperature.
Check cooling mode inlet air temperature. _____ degrees F

(6) Check cooling mode outlet air temperature.
Check cooling mode outlet air temperature. _____ degrees F

(7) Check heating coil water flow.
Check heating coil water flow. _____ gpm

(8) Verify proper operation of heating water control valve. _____

(9) Check heating mode inlet air temperature.
Check heating mode inlet air temperature. _____ degrees F

(10) Check heating mode outlet air temperature.
Check heating mode outlet air temperature. _____ degrees F

Functional Performance Test Checklist - Fan Coil Units

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 Chief 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 _____

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 [2] [10] [10 percent].

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. Check heating mode inlet air temperature. _____ degrees F

d. Check heating mode outlet air temperature. 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 Chief 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 _____

Functional Performance Test Checklist - Steam/Hot Water Converter

For Converter: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of heating system as per specifications including the following: Start building heating equipment to provide load for converter.

a. Verify control system energizes. _____

b. Verify converter senses hot water temperature below set point and control system modulates steam valve. _____

c. Shut off building heating equipment to remove load on heating system. Verify converter steam valve closes after load is removed. _____

2. Verify converter inlet/outlet pressure reading, compare to converter design conditions and manufacturer's performance data.

	DESIGN	ACTUAL
Converter inlet water temp (degrees F)	_____	_____
Converter outlet water temp (degrees F)	_____	_____
Converter inlet steam pressure (psig)	_____	_____
Determine water flow rate based on pressure drop through converter	_____	_____
Determine water flow rate with flow measuring device	_____	_____
Verify that temperature of water is in accordance with outdoor air reset schedule	_____	_____

3. Verify proper operation of converter safeties. _____

4. Check and report 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 Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Functional Performance Test Checklist - Steam/Hot Water Converter

For Converter: [_____]

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Computer Room Unit

For Computer Room Unit: [_____]

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 humidifier operation by varying humidistat set point from space set point to space set point plus 20 percent RH, and returning to space set point. _____

d. Verify that airflow is within +10/-0 percent of design airflow. _____

e. Verify unit shut down during fire event initiated by smoke/heat sensors. _____

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 Chief 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 _____

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 [2] [10] [10 percent].

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.

[g. Change controller set point 10 percent with EMCS and verify correct response.]

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.

Functional Performance Test Checklist - HVAC Controls

For HVAC System: [_____]

Signature and Date

Contractor's Chief 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 _____

Functional Performance Test Checklist - Energy Recovery System

For Energy Recovery System: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of energy recovery system as per specifications including the following: Start equipment to provide energy source for recovery system.

a. Verify energy source is providing recoverable energy. _____

b. Verify recovery system senses available energy and activates. ____

c. Verify that recovery system deactivates when recoverable energy is no longer available. _____

2. Verify recovery system inlet/outlet readings, compare to design conditions and manufacturer's performance data.

	Design	Actual
Primary loop inlet temp (degrees F)	_____	_____
Primary loop outlet temp (degrees F)	_____	_____
Primary loop flow rate	_____	_____
Secondary loop inlet temp (degrees F)	_____	_____
Secondary loop outlet temp (degrees F)	_____	_____
Energy recovered BTU's)	_____	_____

3. Check and report 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 Chief 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 _____

Functional Performance Test Checklist - Energy Recovery System

For Energy Recovery System: [_____]

-- End of Section --

GENERAL DECISION OH020029 01/31/03 OH29

General Decision Number OH020029

Superseded General Decision No. OH010029

State: Ohio

Construction Type:
BUILDING

County(ies):

ADAMS	HANCOCK	OTTAWA
ALLEN	HARRISON	PERRY
ASHLAND	HIGHLAND	PICKAWAY
AUGLAIZE	HOCKING	PIKE
BELMONT	HOLMES	PREBLE
BROWN	HURON	RICHLAND
BUTLER	JACKSON	ROSS
CLERMONT	JEFFERSON	SANDUSKY
CLINTON	KNOX	SCIOTO
COSHOCTON	LICKING	SENECA
CRAWFORD	MADISON	TUSCARAWAS
DELAWARE	MIAMI	VINTON
ERIE	MONROE	WARREN
FAIRFIELD	MONTGOMERY	WASHINGTON
FAYETTE	MORGAN	WAYNE
FRANKLIN	MORROW	WOOD
GREENE	MUSKINGUM	WYANDOT
GUERNSEY	NOBLE	

BUILDING CONSTRUCTION PROJECTS (Does not include single family homes and apartments up to and including four (4) stories)

Modification Number	Publication Date
0	03/01/2002
1	03/22/2002
2	04/05/2002
3	05/03/2002
4	06/21/2002
5	07/05/2002
6	08/09/2002
7	09/13/2002
8	10/04/2002
9	11/15/2002
10	12/13/2002
11	01/10/2003
12	01/17/2003
13	01/31/2003

COUNTY(ies):

ADAMS	HANCOCK	OTTAWA
ALLEN	HARRISON	PERRY
ASHLAND	HIGHLAND	PICKAWAY
AUGLAIZE	HOCKING	PIKE
BELMONT	HOLMES	PREBLE
BROWN	HURON	RICHLAND
BUTLER	JACKSON	ROSS
CLERMONT	JEFFERSON	SANDUSKY
CLINTON	KNOX	SCIOTO
COSHOCTON	LICKING	SENECA
CRAWFORD	MADISON	TUSCARAWAS
DELAWARE	MIAMI	VINTON
ERIE	MONROE	WARREN
FAIRFIELD	MONTGOMERY	WASHINGTON

FAYETTE	MORGAN	WAYNE
FRANKLIN	MORROW	WOOD
GREENE	MUSKINGUM	WYANDOT
GUERNSEY	NOBLE	

ASBE0002B 08/01/2002

	Rates	Fringes
BELMONT, JEFFERSON & MONROE COUNTIES:		
ASBESTOS WORKERS/INSULATORS (Includes application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems)	28.62	11.91

ASBE0003A 05/01/2002

	Rates	Fringes
ERIE (to Sandusky city limits) & HURON COUNTIES:		
ASBESTOS WORKERS/INSULATORS (Includes application of all insulating materials, protective coverings, coatings & finishings to all types of mechanical systems)	28.83	10.05

ASBE0003B 05/01/2002

	Rates	Fringes
ASHLAND, COSHOCTON, HARRISON, HOLMES, RICHLAND, TUSCARAWAS & WAYNE COUNTIES:		
ASBESTOS WORKERS/INSULATORS (Includes application of all insulating materials, protective coverings coatings & finishings to all types of mechanical systems)	22.71	10.05

ASBE0008A 07/01/2002

	Rates	Fringes
ADAMS, BROWN, BUTLER (Including Fairfield, Hanover, Liberty, Milford, Morgan, Oxford, Ripley, Ross, St. Clair, Union & Wayne Townships), CLERMONT, HIGHLAND & WARREN (Including Deerfield, Hamilton, Harlan, Salem, Union & Washington Townships) COUNTIES:		
ASBESTOS WORKERS/INSULATORS (Includes application of all insulating materials, protective coverings, coatings & finishings to all types of mechanical systems)	23.07	7.80

ASBE0041C 07/01/2002

	Rates	Fringes
ALLEN COUNTY:		
ASBESTOS WORKERS/INSULATORS (Includes application of all insulating materials, protective coverings, coatings and finishings to all types of mechanical systems)	23.64	8.51

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 ASBE0044A  07/01/2001
                                        Rates           Fringes
CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY,
 HOCKING, KNOX, LICKING, MADISON, MORGAN, MORROW, MUSKINGUM,
 NOBLE, PERRY, PICKAWAY, ROSS & VINTON COUNTIES:

ASBESTOS WORKERS/INSULATORS (Includes
 application of all insulating
 materials, protective coverings,
 coatins & finisings to all types
 of mechanical systems)                 22.28           7.28
-----------------------------------------------------------------

 ASBE0045A  07/01/2002
                                        Rates           Fringes
ERIE (City limits of Sandusky & Townships of Groton, Margaretta,
 Oxford & Perkins), HANCOCK, OTTAWA, SANDUSKY, SENECA, WOOD &
 WYANDOT COUNTIES:

ASBESTOS WORKERS/INSULATORS (Includes
 application of all insulating
 materials, protective coverings,
 coatings & finishings to all types
 of mechanical systems)                 26.12           11.15
-----------------------------------------------------------------

 ASBE0079A  06/01/2002
                                        Rates           Fringes
AUGLAIZE, BUTLER (Lemon & Madison Townships), CLINTON, GREENE,

 MIAMI, MONTGOMERY, PREBLE & WARREN (Clear Creek, Franklin,
 Massie, Turtle Creek & Wayne Townships) COUNTIES:

ASBESTOS WORKERS/INSULATORS (Includes
 application of all insulating
 materials, protective coverings,
 coatings & finishings to all types
 of mechanical systems)                 22.25           6.44
-----------------------------------------------------------------

 ASBE0080D  06/01/2002
                                        Rates           Fringes
JACKSON, PIKE, SCIOTO & WASHINGTON COUNTIES:

INSULATORS/ASBESTOS WORKERS (Includes
 application of all insulating
 materials, protective coverings,
 coatings and finishings to all
 types of mechanical systems);
& HAZAARDOUS MATERIAL HANDLERS          24.73           10.00
-----------------------------------------------------------------

 ASBE0207I  06/01/2002
                                        Rates           Fringes
ALLEN COUNTY:

HAZARDOUS MATERIAL HANDLERS (Includes
 preparation, wetting, stripping,
 removal, scraping, vacuuming,
 bagging & disposing of all
 insulation materials, whether they
 contain asbestos or not, from
 mechanical systems)                    16.60           5.70
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ASBE0207N 07/01/2002

	Rates	Fringes
HAZARDOUS MATERIAL HANDLERS (Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging & disposing of all insulation materials, whether they contain asbestos or not, from mechanical systems):		
ADAMS, BROWN, BUTLER (Townships of Fairfield, Hanover, Liberty, Milford, Morgan, Oxford, Ripley, Ross, St. Clair, Union & Wayne), CLERMONT, HIGHLAND & WARREN (Townships of Deerfield, Hamilton, Harlan, Salem, Union & Washington) COUNTIES	17.50	6.25
AUGLAIZE, BUTLER (Excluding Townships of Fairfield, Hanover, Liberty, Milford, Morgan, Oxford, Ripley, Ross, St. Clair, Union & Wayne), CLINTON, GREENE, MIAMI, MONTGOMERY, PREBLE & WARREN (Townships of Clear Creek, Franklin, Massie, Turtle Creek & Wayne) COUNTIES	17.50	6.25
ASHLAND, COSHOCTON, ERIE (Post Offices & Townships of: Berlin, Berlin Heights, Birmingham, Florence, Huron, Milan, Shinrock & Vermilion), HARRISON & HURON COUNTIES	17.50	6.25
CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HOCKING, KNOX, LICKING, MADISON, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, ROSS & VINTON COUNTIES	17.50	6.25
ERIE (Portion covered by the city limits of Sandusky, Ohio & by the Townships of Groton, Margaretta, Oxford & Perkins), HANCOCK, OTTAWA, SANDUSKY, SENECA, WOOD & WYANDOT COUNTIES	20.05	5.45
HOLMES, RICHLAND, TUSCARAWAS & WAYNE COUNTIES	14.45	3.60

BOIL0085A 07/15/2002

	Rates	Fringes
ALLEN, ASHLAND, AUGLAIZE, CRAWFORD, DELAWARE, ERIE, HANCOCK, HURON, KNOX, MORROW, OTTAWA, RICHLAND, SANDUSKY, SENECA, WOOD & WYANDOT COUNTIES:		
BOILERMAKERS	26.50	11.70

BOIL0105A 09/30/2002

	Rates	Fringes
ADAMS, BROWN, BUTLER, CLERMONT, CLINTON, FAIRFIELD, FAYETTE, FRANKLIN, GREENE, GUERNSEY, HIGHLAND, HOCKING, JACKSON, LICKING, MADISON, MIAMI, MONTGOMERY, MORGAN, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, PREBLE, ROSS, SCIOTO, VINTON & WARREN COUNTIES:		
BOILERMAKERS	28.30	12.15

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 BOIL0154B  01/01/2003
                                      Rates           Fringes
JEFFERSON COUNTY:

BOILERMAKERS                           28.27          13.35
----------------------------------------------------------------

 BOIL0667B  10/01/2002
                                      Rates           Fringes
BELMONT, MONROE & WASHINGTON COUNTIES:

BOILERMAKERS                           27.30           12.79
----------------------------------------------------------------

 BOIL0744A  01/01/2003

                                      Rates           Fringes
COSHOCTON, HARRISON, HOLMES, TUSCARAWAS & WAYNE COUNTIES:

BOILERMAKERS                           28.10          12.86
----------------------------------------------------------------

 BROH0003A  07/01/2002
                                      Rates           Fringes
WOOD COUNTY (Townships of Perrysburg, Ross, Lake, Troy, Freedom,
 Montgomery, Webster, Center, Portage, Middleton, Plain, Liberty,
 Henry, Washington, Weston, Milton, Jackson & Grand Rapids)

BRICKLAYERS & STONEMASONS              25.20           8.70
----------------------------------------------------------------

 BROH0003D  07/01/1998
                                      Rates           Fringes
WOOD COUNTY (Townships of Perrysburg, Ross, Lake, Troy, Freedom,
 Montgomery, Webster, Center, Portage, Middleton, Plain, Liberty,
 Henry, Washington, Weston, Milton, Jackson & Grand Rapids)

MARBLE SETTERS; TERRAZZO WORKERS;
 & TILE SETTERS                        21.91           4.92
FINISHERS                              18.88           3.85
----------------------------------------------------------------

 BROH0005E  06/01/2002
                                      Rates           Fringes
ASHLAND, ERIE, HURON & RICHLAND COUNTIES:

MARBLE SETTERS' FINISHERS; TILE
 SETTERS' FINISHERS                     22.89          7.10
TERRAZZO WORKERS' FINISHERS             22.92          7.10
----------------------------------------------------------------

 BROH0006A  05/01/2002
                                      Rates           Fringes
TUSCARAWAS COUNTY:

BRICKLAYERS; CAULKERS; CLEANERS;
 POINTERS; & STONEMASONS               22.43           8.05
----------------------------------------------------------------

 BROH0006B  05/01/2002
                                      Rates           Fringes
TUSCARAWAS COUNTY:

MARBLE SETTERS, TERRAZZO WORKERS,
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TERRAZZO GRINDERS & TILE SETTERS	20.30	6.45
FINISHERS	17.90	6.45

BROH0006D 05/01/2002

	Rates	Fringes
TUSCARAWAS COUNTY:		
CEMENT MASONS; PLASTERERS	22.43	8.05

BROH0007A 06/01/2002

	Rates	Fringes
WAYNE COUNTY:		
BRICKLAYERS	25.77	7.73

BROH0007D 06/01/2002

	Rates	Fringes
WAYNE COUNTY (Milton & Chippewa Townships):		
MARBLE SETTERS' FINISHERS; TERRAZZO WORKERS' FINISHERS; & TILE SETTERS' FINISHERS	20.90	5.48

BROH0007F 06/01/2002

	Rates	Fringes
WAYNE COUNTY (Milton & Chippewa Townships):		
MARBLE SETTERS; STONEMASONS; & TERRAZZO WORKERS	24.50	5.48
TILE SETTERS	23.90	5.48

BROH0008F 06/01/1998

	Rates	Fringes
COSHOCTON, HARRISON, HOLMES, JEFFERSON & WAYNE (Excluding Milton & Chippewa Townships) COUNTIES:		
MARBLE SETTERS' FINISHERS & TERRAZZO WORKERS' FINISHERS	19.82	3.86
COSHOCTON, HOLMES, JEFFERSON (Townships of Mt. Pleasant, Warren, Salineville & the Village of Dillonvale), & WAYNE (Excluding Milton & Chippewa Townships) COUNTIES:		
TILE SETTERS' FINISHERS	19.82	3.86

BROH0009A 07/01/2000

	Rates	Fringes
BELMONT, JEFFERSON (Warren & Mt. Pleasant Townships & the Village of Dillonvale) & MONROE COUNTIES:		
BRICKLAYERS & STONEMASONS	22.20	6.08
MARBLE SETTERS; TERRAZZO WORKERS; & TILE SETTERS	21.17	4.98

BROH0010A 06/15/2002

	Rates	Fringes
JEFFERSON COUNTY (Brush Creek & Saline Townships):		
BRICKLAYERS; CAULKERS; CLEANERS; CEMENT BLOCKLAYERS; MARBLE SETTERS; POINTERS; STONEMASONS; TERRAZZO WORKERS; & TILE SETTERS	22.10	7.00
TILE SETTERS' FINISHERS:	20.00	7.00

BROH0014A 07/01/2002

	Rates	Fringes
HARRISON & JEFFERSON (Except Mt. Pleasant, Warren, Brush Creek, Saline & Salineville Townships & the Village of Dillonvale) COUNTIES:		
BRICKLAYERS; STONEMASONS	21.13	9.05
TILE SETTERS	20.61	9.05
TILE SETTERS' FINISHERS	17.61	9.05

BROH0015A 06/01/1999

	Rates	Fringes
NOBLE (Brookfield, Noble, Center, Sharon, Olive, Enoch, Stock, Jackson, Jefferson & Elk Townships) & WASHINGTON COUNTIES:		
BRICKLAYERS; BLOCKLAYERS; CAULKERS; CLEANERS; MARBLE SETTERS; POINTERS; STONEMASONS; TERRAZZO WORKERS; & TILE SETTERS	21.55	4.98

BROH0018A 06/01/2002

	Rates	Fringes
BROWN, BUTLER, CLERMONT, PREBLE (Gasper, Dixon, Israel, Lanier, Somers & Gratis Townships) & WARREN COUNTIES:		
BRICKLAYERS; CAULKERS; CLEANERS; POINTERS; & STONEMASONS	22.96	7.39
REFRACTORY	23.46	7.39

BROH0018D 05/01/2002

	Rates	Fringes
BROWN, BUTLER, CLERMONT, PREBLE (Gasper, Dixon, Israel, Lanier, Somers & Gratis Townships) & WARREN COUNTIES:		
MARBLE SETTERS, TERRAZZO WORKERS & TILE SETTERS	24.42	6.34

BROH0018F 05/01/2002

	Rates	Fringes
ADAMS, BROWN, BUTLER, CLERMONT, FAYETTE, JACKSON, PIKE, ROSS, SCIOTO, VINTON, WARREN & WASHINGTON COUNTIES:		
MARBLE, TERRAZZO & TILE FINISHERS:		
Finishers	19.98	6.34
Marble Sanders, Polishers, Waxers, & Sawyers	20.05	6.34

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 Terrazzo Base Grinders (While
  operating base grinding machine)    20.40           6.34
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 BROH0022A  11/01/2001
                                     Rates           Fringes
CLINTON, GREENE, HIGHLAND, MIAMI, MONTGOMERY & PREBLE (Jackson,
 Monroe, Harrison, Twin, Jefferson & Washington Townships)
 COUNTIES:

BRICKLAYERS; CAULKERS; CLEANERS;
 POINTERS; STONEMASONS                22.50           6.84
-----------------------------------------------------------------

 BROH0022B  11/01/2001
                                     Rates           Fringes
CLINTON, GREENE, HIGHLAND, MIAMI, MONTGOMERY & PREBLE (Jackson,
 Monroe, Harrison, Twin, Jefferson & Washington Townships)
 COUNTIES:

MARBLE SETTERS; TERRAZZO WORKERS; &
 TILE SETTERS                         22.38           4.52
-----------------------------------------------------------------

 BROH0022C  05/01/2001
                                     Rates           Fringes
AUGLAIZE, CLINTON, GREENE, HIGHLAND, MIAMI, MONTGOMERY & PREBLE
 COUNTIES:

FINISHERS                             20.64           1.50
BASE MACHINE                          21.14           1.50
-----------------------------------------------------------------

 BROH0035A  01/01/1999
                                     Rates           Fringes
ALLEN & AUGLAIZE COUNTIES:

BRICKLAYERS; CAULKERS; CLEANERS;
 POINTERS; STONEMASONS; & TILE
 SETTERS                              19.80           5.12
-----------------------------------------------------------------

 BROH0039A  06/01/2001
                                     Rates           Fringes
ADAMS & SCIOTO COUNTIES:

BRICKLAYERS; CAULKERS; CLEANERS;
 MARBLE SETTERS; POINTERS;

 STONEMASONS; TERRAZZO WORKERS; &
 TILE SETTERS                         22.50           8.55
-----------------------------------------------------------------

 BROH0040A  05/01/2002
                                     Rates           Fringes
ASHLAND, CRAWFORD, HOLMES, MORROW, RICHLAND, WAYNE (Except Milton
 & Chippewa Townships) & WYANDOT (Except Crawford, Ridge,
 Richland & Tymochtee Townships) COUNTIES:

BRICKLAYERS; BLOCKLAYERS; CAULKERS;
 CLEANERS; MARBLE SETTERS; POINTERS;
 STONEMASONS; TERRAZZO WORKERS &
 TILE SETTERS                         22.95           8.25
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BROH0040B 05/01/2002

	Rates	Fringes
HOLMES & WAYNE (Except Milton & Chippewa Townships) COUNTIES:		
CEMENT MASONS & PLASTERERS	22.95	8.25

BROH0044A 01/01/1998

	Rates	Fringes
COSHOCTON, FAIRFIELD, KNOX & LICKING COUNTIES:		
BRICKLAYERS; CAULKERS; CLEANERS; POINTERS; & STONEMASONS	18.80	6.10
GUERNSEY, HOCKING, MORGAN, MUSKINGUM, NOBLE (Beaver, Buffalo, Seneca & Wayne Townships) & PERRY COUNTIES:		
BRICKLAYERS; CAULKERS; CLEANERS; POINTERS; & STONEMASONS	18.80	6.10
COSHOCTON COUNTY:		
CEMENT MASONS & PLASTERERS	18.80	6.10
GUERNSEY COUNTY:		
CEMENT MASONS & PLASTERERS	18.80	6.10

BROH0045A 06/01/2000

	Rates	Fringes
FAYETTE, JACKSON, PIKE, ROSS & VINTON COUNTIES:		
BRICKLAYERS; CAULKERS; CEMENT MASONS; CLEANERS; POINTERS; & STONEMASONS	21.25	7.10

BROH0046A 06/01/2002

	Rates	Fringes
ERIE, HANCOCK, HURON, OTTAWA, SANDUSKY, SENECA, WOOD (Perry & Bloom Townships) & WYANDOT (Tymochtee, Crawford, Ridge & Richland Townships) COUNTIES & the islands of Lake Erie north of Sandusky:		
BRICKLAYERS; CAULKERS; CEMENT BLOCK LAYERS; CLEANERS; GUNNITE MASONS; MARBLE SETTERS; POINTERS; REFRACTORY MASONS; STONEMASONS; TERRAZZO WORKERS; & TILE SETTERS	22.58	9.60
ERIE, HURON, OTTAWA, SANDUSKY, SENECA, WOOD (Perry & Bloom Townships) & WYANDOT (Tymochtee, Crawford, Ridge & Richland Townships) COUNTIES & the islands of Lake Erie north of Sandusky:		
CEMENT MASONS & PLASTERERS	22.58	9.60
HANCOCK, OTTAWA, SANDUSKY, SENECA, WOOD (Perry & Bloom Townships) & WYANDOT (Tymochtee, Crawford, Ridge & Richland Townships) COUNTIES & the islands of Lake Erie north of Sandusky:		
MARBLE SETTERS' FINISHERS; TERRAZZO		

WORKERS' FINISHERS; & TILE SETTERS' FINISHERS	18.93	9.60

BROH0055A 06/01/1999

	Rates	Fringes
DELAWARE, FRANKLIN, MADISON & PICKAWAY COUNTIES:		
BRICKLAYERS; CAULKERS; CLEANERS; POINTERS; & STONEMASONS	21.00	6.35
RUBBLE WORK	20.17	6.35

BROH0055B 06/01/1997

	Rates	Fringes
COSHOCTON, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HOCKING, JACKSON, KNOX, LICKING, MADISON, MORGAN, MUSKINGUM, NOBLE (Beaver, Buffalo, Seneca & Wayne Townships), PERRY, PICKAWAY, PIKE, ROSS & VINTON COUNTIES:		
MARBLE SETTERS	21.53	4.55
TERRAZZO WORKERS & TILE SETTERS	19.60	4.50

BROH0055D 06/01/1997

	Rates	Fringes
BELMONT, DELAWARE, FAIRFIELD, FRANKLIN, GUERNSEY, HOCKING, KNOX, LICKING, MADISON, MONROE, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY & PICKAWAY COUNTIES:		
MARBLE, TERRAZZO & TILE FINISHERS	18.50	1.05

CARP0069A 05/01/2002

	Rates	Fringes
TUSCARAWAS & WAYNE COUNTIES:		
CARPENTERS; SOFT FLOOR LAYERS	20.31	7.95

CARP0069G 05/01/2002

	Rates	Fringes
COSHOCTON, HOLMES, KNOX & MORROW COUNTIES:		
CARPENTERS; SOFT FLOOR LAYERS	20.02	7.43

CARP0171A 05/01/2002

	Rates	Fringes
BELMONT, HARRISON, JEFFERSON & MONROE COUNTIES:		
CARPENTERS & SOFT FLOOR LAYERS:	20.12	9.02

CARP0200A 06/01/2000

	Rates	Fringes
DELAWARE, FAIRFIELD, FRANKLIN, GUERNSEY, LICKING, MADISON, MORGAN, MUSKINGUM, NOBLE, PERRY & PICKAWAY COUNTIES:		
CARPENTERS; & SOFT FLOOR LAYERS	20.51	5.68
PILEDRIVERMEN	21.19	5.68

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 CARP0248A  07/01/2001
                                        Rates           Fringes
WOOD COUNTY:

CARPENTERS & LATHERS                     23.90           9.95
-----------------------------------------------------------------

 CARP0248B  07/01/2001
                                        Rates           Fringes
HANCOCK & WOOD COUNTIES:

SOFT FLOOR LAYERS                        22.21           10.95
-----------------------------------------------------------------

 CARP0248C  07/01/2001
                                        Rates           Fringes
HANCOCK COUNTY:

CARPENTERS & LATHERS                     20.05           9.95
-----------------------------------------------------------------

 CARP0356A  06/01/2000
                                        Rates           Fringes
HOCKING, VINTON & WASHINGTON COUNTIES:

CARPENTERS                               20.31           8.03
PILEDRIVERS                              20.61           8.03
SOFT FLOOR LAYERS                        19.91           8.03

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 CARP0372A  07/01/2001
                                        Rates           Fringes
ALLEN & AUGLAIZE COUNTIES:

CARPENTERS & LATHERS                     20.05           8.95
-----------------------------------------------------------------

 CARP0437A  06/01/2000
                                        Rates           Fringes
ADAMS, FAYETTE, HIGHLAND, JACKSON, PIKE, ROSS & SCIOTO COUNTIES:

CARPENTERS; PILEDRIVERMEN &
 SOFT FLOOR LAYERS                       22.18           8.48
-----------------------------------------------------------------

 CARP0735B  05/01/2002
                                        Rates           Fringes
ASHLAND, ERIE, HURON & RICHLAND COUNTIES:

CARPENTERS; SOFT FLOOR LAYERS            19.67           7.67
-----------------------------------------------------------------

 CARP1066A  09/01/1999
                                        Rates           Fringes
BROWN, BUTLER, CLERMONT, CLINTON & WARREN COUNTIES:

MILLWRIGHTS                              21.90           7.92
-----------------------------------------------------------------

 CARP1066B  09/01/1999
                                        Rates           Fringes
GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:
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MILLWRIGHTS	21.90	9.02

CARP1241A 06/01/2000

	Rates	Fringes
DELAWARE, FAIRFIELD, FRANKLIN, GUERNSEY, LICKING, MADISON, MORGAN, MUSKINGUM, NOBLE, PERRY & PICKAWAY COUNTIES:		
MILLWRIGHTS	21.27	9.95

CARP1311B 06/01/2000

	Rates	Fringes
BROWN, BUTLER, CLERMONT, CLINTON & WARREN COUNTIES:		
CARPENTERS & PILEDRIVERMEN: (Does not include Walls & Ceiling Work)	21.35	4.77

CARP1311D 06/01/1998

	Rates	Fringes
GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
CARPENTERS (Does not include Acoustic Ceiling Installers, Drywall Hangers or Metal Stud Framers) & PILEDRIVERMEN	20.60	4.84

CARP1311G 07/01/2000

	Rates	Fringes
BROWN, BUTLER, CLERMONT, CLINTON & WARREN COUNTIES:		
CARPENTERS & LATHERS: (Walls & Ceiling Work only)	21.10	4.98

CARP1311O 08/15/1998

	Rates	Fringes
GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
SOFT FLOOR LAYERS	18.05	4.64

CARP1311P 06/01/1998

	Rates	Fringes
GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
ACOUSTIC CEILING INSTALLERS; DRYWALL HANGERS; LATHERS; & METAL STUD FRAMERS	19.80	4.64

CARP1393A 07/01/2000

	Rates	Fringes
CRAWFORD, HANCOCK, OTTAWA, SANDUSKY, SENECA & WOOD COUNTIES:		
MILLWRIGHTS & PILEDRIVERMEN	21.61	11.07

CARP1393D 07/01/2000

	Rates	Fringes
ALLEN, AUGLAIZE & WYANDOT COUNTIES:		

MILLWRIGHTS & PILEDRIVERMEN 20.68 9.32

CARP1519B 06/01/2000

Rates Fringes

ADAMS, FAYETTE, HIGHLAND, HOCKING, JACKSON, PIKE, ROSS, SCIOTO & VINTON COUNTIES:

MILLWRIGHTS 22.51 10.24

CARP1755C 06/01/2001

Rates Fringes

WASHINGTON COUNTY:

MILLWRIGHTS 24.39 10.16

CARP1871A 05/01/2002

Rates Fringes

ASHLAND, ERIE, HURON & RICHLAND COUNTIES:

MILLWRIGHTS 24.75 8.74

CARP1871B 05/01/2002

Rates Fringes

ASHLAND, ERIE, HURON & RICHLAND COUNTIES:

PILEDRIVERMEN 24.75 8.74

CARP1871C 05/01/2002

Rates Fringes

BELMONT, HARRISON, & MONROE COUNTIES:

PILEDRIVERMEN 22.78 8.97

CARP1871D 05/01/2002

Rates Fringes

COSHOCTON, HOLMES, KNOX & MORROW COUNTIES:

PILEDRIVERMEN 19.53 8.61

CARP1871E 05/01/2002

Rates Fringes

BELMONT, HARRISON, JEFFERSON & MONROE COUNTIES:

MILLWRIGHTS 22.78 8.97

CARP1871K 05/01/2002

Rates Fringes

COSHOCTON, HOLMES, KNOX & MORROW COUNTIES:

MILLWRIGHTS 19.53 8.61

CARP1871L 05/01/2002

Rates Fringes

TUSCARAWAS & WAYNE COUNTIES:

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MILLWRIGHTS                            20.00           8.74
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 CARP1871M  05/01/2002
                                     Rates           Fringes
TUSCARAWAS & WAYNE COUNTIES:

PILEDRIVERMEN                          20.00           8.74
-----------------------------------------------------------------

 CARP2235D  01/01/1999
                                     Rates           Fringes
JEFFERSON COUNTY:

PILEDRIVERMEN                          22.00           7.85
-----------------------------------------------------------------

 CARP2239A  07/01/2001
                                     Rates           Fringes
CRAWFORD, OTTAWA, SANDUSKY, SENECA & WYANDOT COUNTIES:

CARPENTERS                             20.82           9.95

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 ELEC0008A  05/28/2001
                                     Rates           Fringes
HANCOCK, OTTAWA, SANDUSKY, SENECA & WOOD COUNTIES:

ELECTRICIANS:
 Electricians                          28.98           9.30
 Cable Splicers                        30.43           9.37
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 ELEC0032A  12/01/2002
                                     Rates           Fringes
ALLEN, AUGLAIZE & WYANDOT (Crawford, Jackson, Marseilles,
 Mifflin, Ridgeland, Ridge & Salem Townships) COUNTIES:

ELECTRICIANS                           24.87           8.18
-----------------------------------------------------------------

 ELEC0032B  06/01/1998
                                     Rates           Fringes
ALLEN & WYANDOT (Crawford, Jackson, Marseilles, Mifflin,
 Richland, Ridge & Salem Townships) COUNTIES:

LINE CONSTRUCTION:
 Lineman                               22.52           4.31+a
 Equipment Operator                    20.27           4.12+a
 Groundman Truck Driver                14.43           3.63+a

 FOOTNOTE:
  a. Half a day's Paid Holiday:  The last 4 hours of the
  workday prior to Christmas or New Year's Day

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 ELEC0071C  06/03/2002

                                     Rates           Fringes
ASHLAND, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE,
 FRANKLIN, GUERNSEY, HIGHLAND, HOCKING, JACKSON (Coal, Jackson,
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Liberty, Milton, Washington & Wellston Townships), KNOX, LICKING, MADISON, MONROE, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE (Beaver, Benton, Jackson, Mifflin, Pebble, Peepee, Perry & Seal Townships), RICHLAND, ROSS, TUSCARAWAS (Auburn, Bucks, Clay, Jefferson, Oxford, Perry, Salem, Rush, Washington & York Townships), VINTON (Clinton, Eagle, Elk, Harrison, Jackson, Richland & Swan Townships) & WASHINGTON COUNTIES:

LINE CONSTRUCTION:		
Linemen; Cable Splicers	26.00	7.26
Equipment Operators	23.40	6.78
Groundmen	16.90	5.58

ELEC0071D 01/01/2001

	Rates	Fringes
AUGLAIZE, CLINTON, GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
LINE CONSTRUCTION:		
Lineman	24.10	6.66
Equipment Operator	21.69	6.21
Groundman	15.67	5.10

ELEC0071M 01/01/2001

	Rates	Fringes
BELMONT, HARRISON, HOLMES, JEFFERSON & WAYNE COUNTIES:		
LINE CONSTRUCTION:		
Lineman	24.10	6.66
Equipment Operator	21.69	6.21
Groundman	15.67	5.10

ELEC0071N 01/01/2001

	Rates	Fringes
BROWN, BUTLER, CLERMONT & WARREN COUNTIES:		
LINE CONSTRUCTION:		
Lineman	24.10	6.66
Equipment Operator	21.69	6.21
Groundman	15.67	5.10

ELEC0082A 06/03/2002

	Rates	Fringes
CLINTON, GREENE, MIAMI, MONTGOMERY, PREBLE & WARREN (Wayne, Clear Creek & Franklin Townships) COUNTIES:		
ELECTRICIANS	25.29	8.44

ELEC0129F 09/01/2001

	Rates	Fringes
ERIE & HURON (Lyme, Ridgefield, Norwalk, Townsend, Wakeman, Sherman, Peru, Bronson, Hartland, Clarksfield, Norwich, Greenfield, Fairfield, Fitchville & New London Townships) COUNTIES:		
ELECTRICIANS	27.25	6.85

ELEC0141C 06/01/2002

BELMONT COUNTY:	Rates	Fringes
ELECTRICIANS	24.58	10.70
CABLE SPLICERS	24.83	10.70

ELEC0212A 05/28/2001

BROWN & CLERMONT COUNTIES:	Rates	Fringes
ELECTRICIANS	23.53	7.20

ELEC0212B 11/01/2000

BROWN & CLERMONT COUNTIES:	Rates	Fringes
SOUND COMMUNICATIONS:		
Installer	18.00	3.475
Cable Puller	9.00	2.64

ELEC0212D 01/18/1998

BROWN & CLERMONT COUNTIES:	Rates	Fringes
ELECTRICAL SIGN & LUMINOUS BUILDING INSTALLER	12.88	1.03+a

FOOTNOTE:
a. 9 Paid Holidays: New Year's Day, Memorial Day, 4th of July, Labor Day, Thanksgiving Day, the Day after Thanksgiving, Christmas Eve, Christmas Day & New Year's Eve

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ELEC0245A 09/02/2002

HANCOCK, OTTAWA, SANDUSKY, SENECA & WOOD COUNTIES:	Rates	Fringes
LINE CONSTRUCTION:		
Cable Splicer	32.67	9.14+a
Lineman	28.41	8.27+a
Heli-arc Welding	28.71	8.33+a
Technician	27.56	8.11+a
Operator - Class 1	22.73	7.10+a
Operator - Class 2	19.89	6.53+a
Groundman/Truck Driver	16.99	5.92+a

FOOTNOTE:
a. 6 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; & Christmas Day providing the employee has been on the payroll 25 calendar days prior to the holiday, and works the scheduled workdays preceding & following such holiday (except excused absences)

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* ELEC0246A 11/04/2002

HARRISON & JEFFERSON COUNTIES:	Rates	Fringes

ELECTRICIANS	26.00	14.69+a

FOOTNOTE:
a. 1 1/2 Paid Holidays: The last scheduled workday prior to Christmas & 4 hours on Good Friday

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ELEC0306D 06/03/2002

WAYNE (Baughman, Canaan, Chester, Chippewa, Congress, Green, Milton & Wayne Townships) COUNTY:

	Rates	Fringes
ELECTRICIANS:		
Electrician	27.75	8.65
Cable Splicer	29.97	8.75

ELEC0317G 06/01/1998

ADAMS, JACKSON (Bloomfield, Franklin, Hamilton, Lick, Jefferson, Scioto & Madison Townships), PIKE (Camp Creek, Marion, Newton, Scioto, Sunfish & Union Townships), SCIOTO & VINTON (Brown, Knox, Madison, Vinton & Wilkesville Townships) COUNTIES:

	Rates	Fringes
LINE CONSTRUCTION:		
Linemen	21.42	8.40
Cable Splicers	23.66	8.48
Equipment Operators	17.14	8.25
Groundmen	13.92	8.14

ELEC0540A 06/03/2002

HOLMES, TUSCARAWAS (North of Auburn Clay, Rush & York Townships), & WAYNE (South of Baughman, Chester, Green & Wayne Townships) COUNTIES:

	Rates	Fringes
ELECTRICIANS	24.56	11.70

ELEC0540C 06/05/1997

TUSCARAWAS COUNTY (North of Auburn, Clay, Rush & York Townships)

	Rates	Fringes
LINE CONSTRUCTION:		
Lineman; & Cable Splicer	21.86	9.01
Line Equipment Operator	19.02	8.69
Groundman; & Truck Driver	14.65	8.18

ELEC0575A 01/01/2003

ADAMS, FAYETTE, HIGHLAND, HOCKING, JACKSON (Bloomfield, Franklin, Hamilton, Jefferson, Lick, Madison, Scioto, Coal, Jackson, Liberty, Milton & Washington Townships), PICKAWAY (Deer Creek, Perry, Pickaway, Salt Creek & Wayne Townships), PIKE (Beaver, Benton, Jackson, Mifflin, Pebble, PeePee, Perry, Seal, Camp Creek, Newton, Scioto, Sunfish, Union & Marion Townships), ROSS, SCIOTO & VINTON (Clinton, Eagle, Elk, Harrison, Jackson, Richland & Swan Townships) COUNTIES:

	Rates	Fringes
ELECTRICIANS	26.80	7.33

ELEC0575D 11/27/2000

	Rates	Fringes
ADAMS, FAYETTE, HIGHLAND, HOCKING, JACKSON, PICKAWAY (Deer Creek, Perry, Pickaway, Salt Creek & Wayne Townships), PIKE, ROSS, SCIOTO & VINTON (Clinton, Eagle, Elk, Harrison, Jackson, Richland & Swan Townships) COUNTIES:		
SOUND AND COMMUNICATIONS:		
Installer	18.18	4.18
Cable Puller	9.46	3.91

ELEC0648A 09/02/2002

	Rates	Fringes
BUTLER & WARREN (Deerfield, Hamilton, Harlan, Massie, Salem, Turtle Creek, Union & Washington Townships) COUNTIES:		
ELECTRICIANS:		
Electricians	23.53	6.63
Cable Splicers	24.03	6.65

ELEC0683A 06/01/2002

	Rates	Fringes
DELAWARE, FAIRFIELD, FRANKLIN, MADISON & PICKAWAY (Circleville, Darby, Harrison, Jackson, Madison, Monroe, Muhlenberg, Scioto, Walnut & Washington Townships) COUNTIES:		
ELECTRICIANS:		
Electricians	26.20	7.59
Cable Splicers	26.80	7.60

ELEC0683F 11/27/2000

	Rates	Fringes
DELAWARE, FAIRFIELD, FRANKLIN, MADISON & PICKAWAY (Circleville, Darby, Harrison, Jackson, Madison, Monroe, Muhlenberg, Scioto, Walnut & Washington Townships) COUNTIES:		
SOUND AND COMMUNICATIONS:		
Installers	18.17	4.08
Cable Pullers	9.60	3.82

ELEC0688A 12/30/2002

	Rates	Fringes
ASHLAND, CRAWFORD, HURON (Richmond, New Haven, Ripley & Greenwich Townships), KNOX (Liberty, Clinton, Union, Howard, Monroe, Middleberry, Morris, Wayne, Berlin, Pike, Brown & Jefferson Townships), MORROW, RICHLAND & WYANDOT (Sycamore, Crane, Eden, Pitt, Antrim & Tymochtee Townships) COUNTIES:		
ELECTRICIANS	25.17	9.29

ELEC0688B 11/27/2000

	Rates	Fringes
ASHLAND, CRAWFORD, HURON (Richmond, New Haven, Ripley & Greenwich Townships), KNOX (Liberty, Clinton, Union, Howard, Monroe, Middleberry, Morris, Wayne, Berlin, Pike, Brown & Jefferson Townships), MORROW, RICHLAND & WYANDOT (Sycamore,		

Crane, Eden, Pitt, Antrim & Tymochtee Townships) COUNTIES:

SOUND AND COMMUNICATIONS:

Installers	18.23	4.05
Cable Pullers	9.65	3.79

ELEC0867B 06/01/1998

	Rates	Fringes
ERIE COUNTY:		
LINE CONSTRUCTION:		
Lineman; Cable Splicer; & Equipment Operator	20.75	4.09
Truck Driver (Winch) Groundman; & Groundman	13.49	3.87

ELEC0972A 06/01/2000

	Rates	Fringes
MONROE, MORGAN, NOBLE, VINTON (Brown, Knox, Madison, Vinton & Wilkesville Townships) & WASHINGTON COUNTIES:		
ELECTRICIANS:		
Electricians	23.30	12.61
Cable Splicers	23.55	12.62

ELEC1105A 06/04/2001

	Rates	Fringes
COSHOCTON, GUERNSEY, KNOX (Jackson, Clay, Morgan, Miller, Milford, Hilliar, Butler, Harrison, Pleasant & College Townships), LICKING, MUSKINGUM, PERRY & TUSCARAWAS (Auburn, York, Clay, Jefferson, Rush, Oxford, Washington, Salem, Perry & Bucks Townships) COUNTIES:		
ELECTRICIANS	22.12	6.56

ELEC1105B 11/27/2000

	Rates	Fringes
COSHOCTON, GUERNSEY, KNOX (Jackson, Clay, Morgan, Miller, Milford, Hillard, Butler, Harrison, Pleasant & College Townships), LICKING, MUSKINGUM, PERRY & TUSCARAWAS (Auburn, York, Clay, Jefferson, Rush, Oxford, Washington, Salem, Perry & Bucks Townships) COUNTIES:		
SOUND AND COMMUNICATIONS:		
Installer	17.95	4.40
Cable Puller	9.38	4.14

ELEV0006C 01/01/2003

	Rates	Fringes
BELMONT & JEFFERSON COUNTIES:		
ELEVATOR MECHANICS	29.72	9.355+a+b

FOOTNOTES:

a. 7 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; The Day After Thanksgiving; & Christmas Day.

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; Employer contributes 6% of regular hourly rate to vacation pay credit for employee who has worked in business less than 5 years.

ELEV0011A 06/22/2002

	Rates	Fringes
ADAMS, BROWN, BUTLER, CLERMONT, CLINTON, GREENE, HIGHLAND, MIAMI, MONTGOMERY, PREBLE & WARREN COUNTIES:		
ELEVATOR MECHANICS	26.255	7.455+a+b

FOOTNOTES:

a. 7 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; the Day after Thanksgiving; & Christmas Day

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years' service.

ELEV0017A 07/01/2002

	Rates	Fringes
ERIE & HURON COUNTIES:		
ELEVATOR MECHANICS	30.205	7.455+a+b

FOOTNOTES:

a. 7 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Day After Thanksgiving; & Christmas Day

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years.

ELEV0037A 07/16/2000

	Rates	Fringes
ASHLAND, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, HOCKING, HOLMES, KNOX, LICKING, MADISON, MORGAN, MORROW, MUSKINGUM, PERRY, PICKAWAY, RICHLAND, ROSS, TUSCARAWAS & VINTON COUNTIES:		
ELEVATOR MECHANICS	25.335	7.195+a+b

FOOTNOTES:

a. 7 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; the Day after Thanksgiving; & Christmas Day

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years.

ELEV0044A 07/31/2000

	Rates	Fringes
ALLEN, AUGLAIZE, HANCOCK, OTTAWA, SANDUSKY, SENECA, WOOD & WYANDOT COUNTIES:		

ELEVATOR MECHANICS 28.385 7.195+a+b

FOOTNOTES:
a. 7 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; The Day after Thanksgiving; & Christmas Day

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 yrs.; 6% for less than 5 yrs.

ELEV0045A 07/09/2000

	Rates	Fringes
WAYNE COUNTY:		
ELEVATOR MECHANICS	27.305	7.195+a+b

FOOTNOTES:
a. 7 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Day after Thanksgiving; & Christmas Day

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years.

ELEV0048C 09/28/1998

	Rates	Fringes
JACKSON, PIKE & SCIOTO COUNTIES:		
ELEVATOR MECHANICS	22.795	6.12+a+b

FOOTNOTES:
a. 7 Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; the Day after Thanksgiving Day; & Christmas Day

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years' service

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ENGI0018A 05/01/2002

	Rates	Fringes
ADAMS, ALLEN, ASHLAND, AUGLAIZE, BELMONT, BROWN, BUTLER, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GREENE, GUERNSEY, HANCOCK, HARRISON, HIGHLAND, HOCKING, HOLMES, JACKSON, JEFFERSON, KNOX, LICKING, MADISON, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PERRY, PICKAWAY, PIKE, PREBLE, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, TUSCARAWAS, VINTON, WARREN, WASHINGTON, WAYNE & WYANDOT COUNTIES:		
POWER EQUIPMENT OPERATORS:		
GROUP 1	26.09	7.10
GROUP 2	25.84	7.10
GROUP 3	25.59	7.10
GROUP 4	25.34	7.10
GROUP 5	25.22	7.10

GROUP 6	24.18	7.10
GROUP 7	23.00	7.10
GROUP 8	17.84	7.10

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1 - Boom & Jib 250' & Over

GROUP 2 - Boom & Jib Over 180' through 249'

GROUP 3 - Boom & Jib 150' through 180'; & Master Mechanic

GROUP 4 - Barrier Moving Machine; Boiler or Compressor Mounted on Crane (Piggy-Back Operation); Boom Truck; Cableway; Cherry Picker; Combination Concrete Mixer & Tower; Concrete Pump with Booms; Crane; Derrick; Dragline; Dredge (Dipper, Clam or Suction) 3 Man Crew; Elevating Grader or Euclid Loader; Floating Equipment; Forklift(rough terrain with winch/hoist) Gradall; Helicopter Operator & Helicopter Winch Operator (Hoisting Builders Materials); Hoe; Hoist (Two or More Drums); Horizontal Directional Drill; Hydraulic Gantry (Lift System); Laser Finishing Machine; Laser Screed and Like Equipment; Slab or Panel Jack; Locomotive; Maintenance Engineer (Mechanic); Mixer, Paving (Multiple Drum); Mobile Concrete Pump With Boom; Panelboard; Pile Driver; Power Shovel; Prentice Loader; Rail Tamper with automatic lifting & align device; Rotary Drill used on Caisson Work for Foundations & Substructure work; Side Boom; Slip Form Paver; Straddle Carrier; Trench Machine (Over 24" Wide); & Tug Boat

GROUP 5 - Asphalt Paver; Bobcat-type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Bulldozer; C.M.I. Type Equipment; Concrete Grinder/Planer; Endloader; Hydro Milling Machine; Kolman Type Loader (Dirt Loading); Lead Greaseman; Mucking Machine; Pettibone-Rail Equipment; Power Grader; Power Scoop; Power Scraper; Push Cat; & Vermeer Type Concrete Saw

GROUP 6 - A-Frame; Air Compressor (Pressurizing Shafts or Tunnels); Asphalt Roller; Bobcat-type and/or Skid Steer Loader with or without Attachments; Concrete Pump without Booms & with 5" System; Highway Drillers with Integral Power; Hoist (One Drum); Boiler (15 lbs. pressure & over); ForkLift (except Masonry); House Elevator (except those automatic call button controlled); Man Lift; Mud Jack; Pressure Grouting; Pump (Installing or Operating Well Points or other Type of Dewatering Systems); Pump (4" and over Discharge); Submersible Pump (4" and over Discharge); Switch & Tie Tamper w/o lifting & aligning device; Trench Machine (24" & under); Utility; Railroad Tie Inserter/Remover; & Rotovator (Lime-Soil Stabilizer)

GROUP 7 - Compressor; Concrete Mixer (Capacity more than one bag); Concrete Mixer (one bag capacity, side loader); Conveyor; Generator; Gunite Machine; Pavement Breaker (Hydraulic or

Cable); Post Driver; Post Hole Digger; Road Widening Trencher; Roller (except Asphalt); Ballast Relocator; Backfiller & Tamper; Bar & Joint Installing Machine; Batch Plant; Bullfloat; Burlap & Curing Machine; Clefplane; Concrete Spreader; Crusher; Deckhand; Drum Fireperson (In Asphalt Plant); Farm-type Tractor (Pulling Attachments); Finishing Machine; Form Trencher; Hydro Seeder; Pressure Pump (over 1/2" discharge); Self-propelled Sub-Grader; Tire Repairman; Tractor (Pulling

Sheep Foot Roller or Grader); Vibratory Compactor (with Integral Power); Vac/All; Concrete Pump without Booms with 4" or Smaller System; Self-Propelled Power Spreader; & Shotcrete Machine

GROUP 8 - Allen Screed Paver(concrete); Boiler (Less than 15 lbs. pressure); Directional Drill "Locator"; Masonry Fork Lift; Inboard & Outboard Motor Boat Launch; Light Plant; Oiler; Power Driven Heater (Oil Fired); Power Scrubber; Power Sweeper; Pump (Under 4" discharge); Signal Person; & Submersible Pump (Under 4" discharge)

ENGI0018B 05/01/2002

	Rates	Fringes
ERIE & HURON COUNTIES:		
POWER EQUIPMENT OPERATORS:		
Crane (Boom & Jib 300' & Over)	29.17	7.06
Crane (Boom & Jib 200' & Over, Up to 299'); Master Mechanic	28.92	7.06
GROUP 1	28.42	7.06
GROUP 2	28.27	7.06
GROUP 3	27.12	7.06
GROUP 4	26.34	7.06
GROUP 5	26.02	7.06
GROUP 6	19.24	7.06

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1 - A-Frame; Boiler or Compressor Operator, Hydraulic Pump & Power Pacs Mounted on Crane (Piggy-Back Operation); Boom Truck; Cableway; Cherry Picker; Combination Concrete Mixer & Tower; Concrete Pump; Derrick; Dragline; Dredge (Dipper, Clam or Suction) 3 Man Crew; Elevating Grader or Euclid Loader; Floating Equipment; Gradall; Helicopter Operator & Helicopter Winch Operator (When Hoisting Builders Materials); Hoe; Hoist (Two or More Drums); Lift Slab or Panel Jack Operator; Locomotive; Maintenance Engineer (Mechanic); Mixer Paving (Multiple Drum); Mobile Concrete Pump, with Boom; Panelboard; Pile Driver; Power Shovel; Robotic Equipment; Operator/Mechanic; Rotary Drill used on Caisson Work for Foundations & Substructure Work; Side Boom; Slip Form Paver; Straddle Carrier; Trench Machine (Over 24" Wide); & Tug Boat

GROUP 2 - Asphalt Paver; Bulldozer; C.M.I. Type Equipment; End Loader; Kohlman Type Loader (Dirt Loading); Lead Greaseman; Mucking Machine; Power Grader; Power Scoop; Power Scraper; &

Push Cat; Horizontal Directional Drill Locator; Horizontal & Directional Drill Operator

GROUP 3 - Air Compressor (Pressurizing Shafts & Tunnels); Asphalt Roller; Fork Lift; Hoist (One Drum); House Elevator (Except Automatic Call Button-controlled); Man Lift; Mud Jack; Power Boiler (Over 15 lbs. Pressure); Pressure Grouting; Pump Operator (Installing Well Points or other type of Dewatering system); Trencher (24" & under); & Utility Operator

GROUP 4 - Compressor; Conveyor; Generator; Gunite Machine; Concrete Mixer (Capacity more than one bag); Concrete Mixer (One Bag capacity, Side Loader); Pavement Breaker (Hydraulic or Cable); Post Driver; Post Hole Digger; Road Widening Trencher; & Roller

GROUP 5 - Backfiller & Tamper; Bar & Joint Installing Machine; Batch Plant; Bullfoat; Burlap and Curing Machine; Cleaning Machine (decontamination included); Clefplane; Concrete Spreader Machine; Crusher; Deck Hand; Drum Fireman (In Asphalt Plant); Farm-type Tractor (Pulling attachment); Finishing Machine; Fork Lift (Masonry Work); Form Trencher High Pressure Pump (Over 1/2" discharge); Hydro Seeder; Pump (4" and Over discharge); Sub-mersible Pump (4" and Over discharge); Self-propelled Power Spreader; Self-propelled Sub-grader; Tire Repairman; Tractor (Pulling Sheeps Foot Roller or Grader); & Vibratory Compactor (With Integral Power)

GROUP 6 - Inboard & Outboard Motor Boat Launch; Light Plant Operator; Oiler; Power Driven Heater (Oil Fired); Power Scrubber; Power Sweeper; Power Boiler (Less than 15 lbs. Pressure); Pump (Under 4" discharge); Submersible Pump (Under 4" discharge); Signalperson; Bob Cat-type and/or Skid Steer Loader; Grade Checker; & VAC/ALL

ENGI0018G 05/01/2002

	Rates	Fringes
WOOD COUNTY:		
POWER EQUIPMENT OPERATORS:		
GROUP 1	26.84	7.10
GROUP 2	26.59	7.10
GROUP 3	26.34	7.10
GROUP 4	26.09	7.10
GROUP 5	25.97	7.10
GROUP 6	24.93	7.10
GROUP 7	23.75	7.10
GROUP 8	18.59	7.10

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1 - Boom & Jib 250' & Over

GROUP 2 - Boom & Jib Over 180' through 249'

GROUP 3 - Boom & Jib 150' through 180'; & Master Mechanic

GROUP 4 - Barrier Moving Machine; Boiler or Compressor Mounted on Crane (Piggy-Back Operation); Boom Truck; Cableway; Cherry Picker; Combination Concrete Mixer & Tower; Concrete Pump with Booms; Crane; Derrick; Dragline; Dredge (Dipper, Clam or Suction) 3 Man Crew; Elevating Grader or Euclid Loader; Floating Equipment; Forklift(rough terrain with winch/hoist) Gradall; Helicopter Operator (Hoisting Builders Materials); Helicopter Winch Operator (Hoisting Building Materials); Hoe; Hoist (Two or More Drums); Horizontal Directional Drill; Hydraulic Gantry (Lift System); Laser Finishing Machine; Laser Screed and Like Equipment; Lift Slab or Panel Jack; Locomotive; Maintenance Engineer (Mechanic); Mixer Paving (Multiple Drum); Mobile Concrete Pump (With Boom); Panelboard; Pile Driver; Power Shovel; Prentice Loader; Concrete Pump with Boom; Rail Tamper with automatic lifting & align device; Rotary Drill used on Caisson Work for Foundations & Substructure work; Side Boom; Slip Form Paver; Straddle Carrier; Trench Machine (Over 24" Wide); & Tug Boat

GROUP 5 - Asphalt Paver; Bobcat-type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Bulldozer; Power

Grader; C.M.I. Type Equipment; Concrete Grinder/Planer; Endloader; Push Cats; Hydro Milling Machine; Kolman Type Loader (Dirt Loading); Lead Greaseman; Mucking Machine; Pettibone-Rail Equipment; Power Scoop; Power Scraper; & Vermeer Type Concrete Saw

GROUP 6 - A-Frame; Air Compressor (Pressurizing Shafts or Tunnels); Asphalt Roller; Bobcat-type and/or Skid Steer Loader with or without Attachments; Highway Drillers with Integral Power; Hoist (One Drum); Boiler (15 lbs. pressure & over); Concrete Pump without Booms with 5" System; ForkLift (except Masonry); House Elevator (except those automatic call button controlled); Man Lift; Mud Jack; Pressure Grouting; Pump (Installing or Operating Well Points or other Type of Dewatering Systems); Pump (4" and over Discharge); Submersible Pump (4" and over Discharge); Switch & Tie Tamper w/o lifting & aligning device; Trench Machine (24" & under); Utility; Railroad Tie Inserter/Remover; & Rotovator (Lime-Soil Stabilizer)

GROUP 7 - Compressor; Concrete Mixer (Capacity more than one bag); Concrete Mixer (one bag capacity, side loader); Conveyor; Generator; Gunite Machine; Pavement Breaker (Hydraulic or Cable); Post Driver; Post Hole Digger; Road Widening Trencher; Roller (except Asphalt); Ballast Relocator; Backfiller & Tamper; Bar & Joint Installing Machine; Batch Plant; Bullfloat; Burlap & Curing Machine; Clefplane; Concrete Spreader; Crusher; Deckhand; Drum Fireperson (In Asphalt Plant); Farm-type Tractor (Pulling Attachments); Finishing Machine; Form Trencher; Hydro Seeder; Pressure Pump (over 1/2" discharge); Self-propelled Sub-Grader; Tire Repairman; Tractor (Pulling Sheep Foot Roller or Grader); Vibratory Compactor (with Integral Power); Vac/All; Concrete Pump without Booms & With 4" System or Smaller; Self-

Propelled Power Spreader; & Shotcrete Machine

GROUP 8 - Allen Screed Paver(concrete); Boiler (Less than 15 lbs. pressure); Directional Drill "Locator"; Masonry Fork Lift; Inboard & Outboard Motor Boat Launch; Light Plant; Oiler; Power Driven Heater (Oil Fired); Power Scrubber; Power Sweeper; Pump (Under 4" discharge); Signal Person; & Submersible Pump (Under 4" discharge)

IRON0017A 08/01/2002

	Rates	Fringes
ERIE (Eastern 2/3) & HURON (East of a line drawn from the north border through Monroeville & Willard) COUNTIES:		
IRONWORKERS:		
Ornamental; Reinforcing & Structural	25.55	13.63

IRON0044A 06/01/2002

	Rates	Fringes
ADAMS (Western Part), BROWN, BUTLER (Southern Part), CLERMONT, CLINTON (South of a line drawn from Blanchester to Lynchburg), HIGHLAND (Excluding eastern one-fifth & portion of county inside lines drawn from Marshall to Lynchburg from the northern county line through E. Monroe to Marshall) & WARREN (South of a line drawn from Blanchester through Morrow to the west county line) COUNTIES:		
IRONWORKERS:		

Ornamental; Structural	23.45	10.88
Fence Erector	21.11	10.88

IRON0055A 07/01/2002

	Rates	Fringes

CRAWFORD (Area between lines drawn from where Hwy #598 & #30 meet through North Liberty to the northern border & from said Hwy junction point due west to the border), ERIE (Western one-third), HANCOCK, HURON (West of a line drawn from the northern border through Monroeville & Willard), OTTAWA, SANDUSKY, SENECA, WOOD & WYANDOT (North of Rte. #30) COUNTIES:

IRONWORKERS:		
Fence Erector	18.43	12.02
Pre-Engineered Metal Building	19.43	12.41
Furnaces & Kilns (Temperature units over 125 degrees Fahrenheit)	25.15	12.41
All Other Work	24.15	12.41

IRON0147B 06/01/2002

	Rates	Fringes

ALLEN COUNTY (Northern half):

IRONWORKERS	21.85	10.92

IRON0172A 06/01/2002

	Rates	Fringes

COSHOCTON (West of a line beginning at the northwest county line going through Walhonding & Tunnel Hill to the southern county line), CRAWFORD (South of Rte. #30), DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, HIGHLAND (Eastern one-fifth), HOCKING, JACKSON (Northern half), KNOX, LICKING, MADISON, MORROW, MUSKINGUM (West of a line starting at Adams Mill going to Adamsville & going from Adamsville through Blue Rock to the southern border), PERRY, PICKAWAY, PIKE, ROSS, VINTON & WYANDOT (South of Rte. #30) COUNTIES:

IRONWORKERS	23.90	10.41

IRON0290A 06/01/2002

	Rates	Fringes

ALLEN (Southern half), AUGLAIZE, BUTLER (North of a line drawn from east to the west county line going through Oxford, Darrtown & Woodsdale), CLINTON (Excluding south of a line drawn from Blanchester to Lynchburg), GREENE, HIGHLAND (Inside lines drawn from Marshall to Lynchburg & from the northern county line through East Monroe to Marshall), MIAMI, MONTGOMERY, PREBLE & WARREN (Excluding south of a line drawn from Blanchester through Morrow to the west county line) COUNTIES:

IRONWORKERS		
Within 25 mile radius of L.U. #290 Office, Dayton	23.10	10.75
Beyond 25 mile radius of L.U. #290 Office, Dayton	23.25	10.75

IRON0372A 06/01/2002

	Rates	Fringes

ADAMS (Western Part), BROWN, BUTLER (Southern Part), CLERMONT, CLINTON (South of a line drawn from Blanchester to Lynchburg), HIGHLAND (Excluding eastern one-fifth & portion of county inside lines drawn from Marshall to Lynchburg from the northern county line through E. Monroe to Marshall) & WARREN (South of a line drawn from Blanchester through Morrow to the west county line) COUNTIES:

IRONWORKERS, Reinforcing:		
Up to & including 30-mile radius of Hamilton County Courthouse	22.71	10.47
Beyond 30-mile radius of Hamilton County Courthouse	22.96	10.47

IRON0549C 07/01/2002

	Rates	Fringes
BELMONT, GUERNSEY, HARRISON, JEFFERSON, MONROE & MUSKINGUM (Excluding portion west of a line starting at Adams Mill going to Adamsville & going from Adamsville through Blue Rock to the south border) COUNTIES:		
IRONWORKERS	24.78	12.41

IRON0550A 05/01/2002

	Rates	Fringes
ASHLAND, COSHOCTON (E. of a line beginning at NW Co. line going through Walhonding & Tunnel Hill to the South Co. line), HOLMES, HURON (S. of Old Route #224), RICHLAND, TUSCARAWAS & WAYNE COUNTIES:		
IRONWORKERS:		
Ornamental; Reinforcing; & Structural	21.26	11.42
Fence Erector	17.53	11.42

IRON0769C 06/01/2002

	Rates	Fringes
ADAMS (Eastern Half), JACKSON (Southern Half) & SCIOTO COUNTIES:		
IRONWORKERS:		
ZONE 1	24.92	11.14
ZONE 2	25.32	11.14
ZONE 3	27.32	11.14

ZONE 1 - Up to 10 mile radius of Union Hall, Ashland, Ky., 1643 Greenup Ave.

ZONE 2 - 10 to 50 mile radius of Union Hall, Ashland, Ky., 1643 Greenup Ave.

ZONE 3 - 50 mile radius & over of Union Hall, Ashland, Ky., 1643 Greenup Ave.

IRON0787B 06/01/2002

	Rates	Fringes
MORGAN, NOBLE & WASHINGTON COUNTIES:		
IRONWORKERS	24.33	10.90

LABO0083A 06/01/2002

ADAMS, HIGHLAND, JACKSON, PIKE, ROSS, SCIOTO & VINTON COUNTIES:	Rates	Fringes
LABORERS:		
GROUP 1	24.47	4.40
GROUP 2	24.72	4.40
GROUP 3	24.97	4.40

LABORER CLASSIFICATIONS

GROUP 1 - Building & Construction; Carpenter Tender; Bottom Man; Mason Tender; Mortar Mixer; Pipe Layer; Plasterer Tender; Sheeting & Shoring Man; & Signalman

GROUP 2 - Air & Machine Driver Tool Operator; Asphalt Raker & Smoother; Burning & Cutting Torch; Chain Saw; Form Setter (Street & Highway); Hand Spiker; & Powered Concrete Buggy

GROUP 3 - Gunnite Machine Operator; Gunnite Nozzle Man; Miner (Tunnel & Caisson); Mucker (Tunnel & Caisson); & Powder Man & Blaster

HAZARDOUS & HIGH WORK IN EXCESS OF 25 FEET ABOVE SOLID BASE - $.25 PREMIUM

WORKERS HANDLING CREOSOTED OR INJURIOUS CHEMICALLY TREATED MATERIALS - $.25 PREMIUM

THE ERECTION, ALTERATION, REPAIR OR DEMOLITION OF REINFORCED CONCRETE CHIMNEYS, MASONRY CHIMNEYS, SILOS, & FURNACES RECEIVE THE FOLLOWING RATES:

0 TO 25 FEET - BASE RATE; 25 TO 100 FEET - $1.00 PREMIUM;
100 TO 150 FEET - $1.25 PREMIUM; 150 TO 200 FEET - $1.50 PREMIUM;
200 TO 250 FEET - $1.75 PREMIUM; OVER 250 FEET - $2.00 PREMIUM

LABO0134A 05/01/2002

COSHOCTON, HOLMES & TUSCARAWAS COUNTIES:	Rates	Fringes
LABORERS:		
GROUP 1	18.96	4.40
GROUP 2	19.26	4.40
GROUP 3	19.74	4.40
GROUP 4	20.01	4.40

LABORER CLASSIFICATIONS

GROUP 1 - Building & Construction; Signalman; Flagman; Carpenter Tender; Finisher Tender; Concrete Handler; Utility Construction; Guard Rail Erector; & Hazardous Waste Removal (Level D) Personal Protective Equipment (PPE)

GROUP 2 - Bottom Man; Scaffold Builder; Tunnel; Pipe Layer; Air & Power Driven Tool; Burner on Demolition Work; Swinging Scaffold; Mucker; Caisson Worker; Cofferdam Worker; Powder Man & Dynamite Blaster; Creosote Worker; Form Setter; Plasterer Tender; Hod Carrier; All Confined Space Work; Furnaces; Pickel Tubs; Acid Pits & Hazardous Waste Removal (Level C) Personal Protective Equipment (PPE)

GROUP 3 - Mason Tender; Mortar Mixer; Stonemason Tender; Skid Steer Loader; & Hazardous Waste Removal (Level B) Personal Protective Equipment (PPE)

GROUP 4 - Gunnite Operator; & Hazardous Waste Removal (Level A) Personal Protective Equipment (PPE)

LABO0265A 06/01/2002

	Rates	Fringes
BROWN, CLERMONT & CLINTON COUNTIES:		
LABORERS:		
GROUP 1	20.00	4.65
GROUP 2	20.10	4.65
GROUP 3	20.15	4.65
GROUP 4	20.20	4.65
GROUP 5	20.50	4.65
GROUP 6	20.75	4.65

LABORER CLASSIFICATIONS

GROUP 1 - Building and Common Laborer; Asbestos Removal; Cement Mason Tender; Hand-Operated Mechanical Mule; Mechanical Mule; Mechanical Sweeper; Signaler; Flagger; Wrecking Laborer

GROUP 2 - Bottom Man; Pipe Layer

GROUP 3 - Skid Steer; Burning Torch Operator; Jack Hammer; Air Spade; Chipping Hammer; Mechanical and Air Tamper Operator; Mechanical Concrete Buggie; Power Operated Mechanical Mule; Concrete Pump Hose Man; Vibrator Man; CERCLA Trained Hazardous Material Removal-Levels A,B,C

GROUP 4 - Bottom Jack Hammer Man

GROUP 5 - Tunnel Laborer

GROUP 6 - Gunnite Nozzle Operator

LABO0265C 06/01/1997

	Rates	Fringes
BROWN, CLERMONT & CLINTON COUNTIES:		
PLASTERERS' TENDERS:		
Tender	18.30	3.90
Mixer Pump Operator	18.45	3.90

LABO0265G 06/01/2002

	Rates	Fringes
BROWN, CLERMONT & CLINTON COUNTIES:		
LABORERS, Mason Tenders	21.65	4.65

LABO0329A 05/01/2002

	Rates	Fringes
ALLEN & AUGLAIZE COUNTIES:		
LABORERS:		

GROUP 1	19.40	4.40
GROUP 2	19.55	4.40
GROUP 3	19.70	4.40
GROUP 4	19.90	4.40

LABORER CLASSIFICAITONS

GROUP 1 - Building; Signal Person; Power Wheelbarrow or Power Buggy; Removal of Asbestos & Hazardous Waste (Levels C & D)

GROUP 2 - Vibrator; Cement Finisher Tender; Cement Raker; Asphalt Raker; Tamper & Packer; Pump Man Under 4" Discharge; Caisson; Cofferdam; Tunnel Spiker Railroad (By Hand); Pot Tender; Torch Man; Demolition; Machine Driven Tools (Gas, Electric, Air)

GROUP 3 - Plaster Tender; Mortar Mixer; Cylinder, Shaft; Sewer, Water Conduit; Gas, Oil Pipeline, except Mainlines; Sewer Bottom Man; Sewer Pipe Layer; Manhole Builder; Blaster Tender; Wagon Drill Tender; Jack Hammer; Gunnite Operator; Mucker (Tunnel & Caisson) Free Air; Miner (Tunnel & Caisson) Free Air; Sand Blaster; Blaster-Powder Man; Wagon Drill/Operator; & Removal of Toxic & Hazardous Waste (Levels A & B)

GROUP 4 - Mason Tender

LABO0423A 06/01/2002

FAIRFIELD, FAYETTE, FRANKLIN, HOCKING, LICKING, MADISON & PICKAWAY COUNTIES:

	Rates	Fringes
LABORERS:		
GROUP 1	18.98	4.40
GROUP 2	19.29	4.40
GROUP 3	19.60	4.40
GROUP 4	19.91	4.40

LABORER CLASSIFICATIONS

GROUP 1 - General laborers; Carpenter tender; Cathodic protection; Cleaning debris; Cleaning of all material; General clean-up including vacuum cleaning, scraping and cleaning of walls and floors; Landscape; Installation and removal of fencing; Sod layers; All portable heaters; Flagman; Loading and unloading of all trucks; Handling and conveying all materials; Washing of all windows; Conveyer belt; Jurisdiction over the use of all water pumps up to and including 3 inch intake

GROUP 2 - Skid steer specialist; Concrete specialist; Brick tender; Stone mason tender; Plaster tender; Mortar mixer and; operator; Cement mason tender; Construction specialist;

All scaffold builders; Bush hammering; Jack hammer operator; Air or electrical pneumatic tool operator; Power driven tools; Power buggy operators; Pouring and placement of all concrete; Power wheelbarrow operator; Asphalt and blacktop rakers; Wall wrecker and bar man on demolition; Sand blasting and chipping; Welders on demolitions; Grade checkers; A person on a bucket pouring concrete; Gunite nozzle man; Wagon and churn drill operator; Concrete saw operator; Brush feeders on pulverizers; Pipe layers; Pavers set in sand; Bottom man; Laser gun; Burners; Sand blasting of concrete; Vibrator man; Steward;

Signal man; Caisson; Caisson bottom man; Pile drivers; Asbestos and lead abatement laborers; Hazardous waste level B

GROUP 3 - Hazardous waste level C

GROUP 4 - Hazardous waste level D

LABO0480A 06/01/2002

	Rates	Fringes
ERIE, HURON, OTTAWA & SANDUSKY COUNTIES:		
LABORERS:		
GROUP 1	21.91	4.40
GROUP 2	22.11	4.40
GROUP 3	22.51	4.40

LABORER CLASSIFICATIONS

GROUP 1 - Building & Construction Laborer; Carpenter Tender; Concrete Handler; Finisher Tender; Guard Rail Erector; Railroad Spur Work; Utility Construction Laborer; Signal Person; & Flagperson

GROUP 2 - Air & Power Driven Tool; Bottom Man; Burner on Demolition Work; Caisson Worker; Cofferdam Worker; Creosote Worker; Form Setter; Hod Carrier; Mason Tender; Mortar Mixer; Mucker; Pipelayer; Plasterer Tender; Powder Man & Dynamite Blaster; Scaffold Builder; Stonemason Tender; Swinging Scaffold; Tunnel Laborer; & Wet & Dry Vacuum Devices

GROUP 3 - Caustic Lime Worker; Dry Sandblast; Gunnite Operator; Radioactive Atmosphere Worker (Special wearing apparel required); Asbestos Removal; & Hazardous Waste Removal

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LABO0500A 07/01/2002

	Rates	Fringes
WOOD COUNTY:		
LABORERS:		
GROUP 1	19.30	6.97
GROUP 2	19.50	6.97
GROUP 3	19.70	6.97
GROUP 4	19.80	6.97
GROUP 5	9.78	6.97
GROUP 6	12.80	6.97

LABORER CLASSIFICATIONS

GROUP 1 - Building & Construction; Signalperson; Flagperson; Carpenter Tender; Utility Construction; Guard Rail Erector; Deep Cleaning; & Hazardous Waste (Level A)

GROUP 2 - Finisher Tender; Concrete Handler; Bottom Man; Scaffold Builder; Tunnel Laborer; Pipelayer; Air & Power Driven Tools; Burner on Demolition Work; Swinging Scaffold; Mucker; Caisson Worker; Cofferdam Worker; Powder Man & Dynamite Blaster; Creosote Worker; Mortar Mixer; Form Setter; Mason Tender; Plasterer Tender; Hod Carrier; Stonemason Tender & Hazardous Waste (Level B)

GROUP 3 - Gunite Operator & Hazardous Waste (Level C)

GROUP 4 - Hazardous Waste (Level D)

GROUP 5 - Parking & Landscaping

GROUP 6 - Installation of Fencing

FIREBRICK WORK OVER 50 FEET, EXPEDITERS, HOT PAY, BOTTOM MAN & TOP MAN - $.75 PER HOUR OVER GROUP 1.

LABO0530A 06/01/2002

	Rates	Fringes
GUERNSEY, MUSKINGUM, NOBLE & PERRY COUNTIES:		
LABORERS:		
GROUP 1	18.57	4.40
GROUP 2	18.82	4.40
GROUP 3	19.07	4.40
GROUP 4	20.07	4.40

LABORER CLASSIFICATIONS

GROUP 1 - Building & Construction; Carpenter Tender; Tree Planter; Landscape Tree Trimmer; & Asbestos Removal, Hazardous Waste Removal

GROUP 2 - Air & Machine Driven Tool Operator; Asphalt Plant Aggremeter Operator; Asphalt Plant Mixer Man; Car Pusher and Tunnel Laborer; Caulker; Cement Handler; Concrete Puddler (Behind Mixer); Curb Cutter & Setter; Cutting with Burning Torch; Dumpman; Hand Spiker (Railroad); Jackhammer Operator; Mucker (Tunnel & Caisson); Pipelayer; Proportioning Plant Operator; Pump Man; Road Form Setter; Sewer Bottom Man; Sheeting & Shoring Man; Vibrator Operator; & Yarner & Wrench Man

GROUP 3 - Mason Tender; Mortar Mixer Man; Brick Slinger;

Stone Mason Tender; Plaster Tender; Lock Tender; Brick Dropper

GROUP 4 - Powder Man or Blaster; & Toxic/Hazardous Waste

LABO0534A 06/01/2002

	Rates	Fringes
BUTLER & WARREN COUNTIES:		
LABORERS:		
GROUP 1	20.14	4.40
GROUP 2	20.24	4.40
GROUP 3	20.34	4.40
GROUP 4	20.47	4.40
GROUP 5	20.72	4.40
GROUP 6	20.49	4.40
GROUP 7	20.74	4.40
GROUP 8	20.63	4.40
GROUP 9	20.59	4.40
GROUP 10	20.84	4.40

LABORER CLASSIFICATIONS

GROUP 1 - Building & Common Laborer; Rough Rider - 4" Small Pump; Portable Generator - Bobcat to Cleanup

GROUP 2 - Asphalt Raker; Chisel; Hand Air Pump; Hand Air Tamper; Handling & Laying Precast Concrete Floor & Deck; Power Tamper Operator; Smoother; Switch Assemblies; & Tamper

GROUP 3 - Concrete Specialist; Skid Steer (to perform laborers' duties); Jack Hammer and Concrete Busterman; Barco Tamper Man; Power Georgia Buggy Man; Power Sweeper Man; Vibrator; Concrete Saw Man; Rail Spikers; Acetylene Burner Pipe Layers; Bos'N or Cradleman; Bottom Man; Chipping Hammer Grade Checker; Form Cleanout and Blowout Man; Red Concrete Coloring Man (Electrical Safety)

GROUP 4 - Mason Tender; Mortar Mixer & Scaffold Builder

GROUP 5 - Forklift for Mason; Work involving Refractory Materials, including Demolition; Asbestos Removal & Hazardous Waste Removal (Handling, control, removal, abatement, encapsulation or disposal of asbestos & hazardous waste)

GROUP 6 - Gunnite Man; Sand Blaster Concrete Pump & Hose Man; & Blast Trac

GROUP 7 - Miner & Mucker, Free Air

GROUP 8 - Powderman or Blaster Above Ground

GROUP 9 - Mortar or Gypsum Machineman

GROUP 10 - Powderman Underground; & Scuba Diva

LABO0574A 05/01/2002

	Rates	Fringes
DELAWARE COUNTY:		
LABORERS:		
GROUP 1	18.98	4.40
GROUP 2	19.29	4.40
GROUP 3	19.60	4.40
GROUP 4	19.91	4.40
HANCOCK, SENECA & WYANDOT COUNTIES:		
LABORERS:		
GROUP 1	20.55	4.40
GROUP 2	20.85	4.40
GROUP 3	21.05	4.40
GROUP 4	21.25	4.40

LABORER CLASSIFICATIONS

GROUP 1: Building & Construction; Signalman; Flagman; Carpenter Tender; Finisher Tender; Concrete Handler; Utility Construction; Guard Rail Erector; Fence Installer; Caulker; & Hazardous Waste (Level A)

GROUP 2: Bottom Man; Scaffold; Mucker; Caisson Worker; Powder Man; Dynamite Blaster; Creosote Worker; Mortar Mixer; Form Setter; Plasterer Tender; Hod Carrier; Stonemason Tender & Hazardous Waste (Level B)

GROUP 3: Mason Tender; Gunite Operator & Hazardous Waste (Level C)

GROUP 4: Hazardous Waste (Level D)

LABO0639A 06/01/2002

	Rates	Fringes
MONROE, MORGAN & WASHINGTON COUNTIES:		
LABORERS:		
GROUP 1	23.02	4.40
GROUP 2	23.37	4.40

LABORER CLASSIFICATIONS

GROUP 1 - Asphalt Plant Aggremeter; Asphalt Plant Miner Man; Brick Slinger; Building & Construction; Car Pusher & Tunnel Laborer; Carpenter Tender; Cement Handler; Concrete Puddler Behind Mixer; Concrete Smoother; Drum Fireperson; Dump Man Batch Truck; Flagperson; Landscape Planter; Proportioning Plant Operator; Rammer Man; & Spreader Box Man

GROUP 2 - Air, Gas or Machine Driven Tool; Asphalt Raker; Tamper, Forker, Shoveler or Smoother; Caulker, Yarner & Wrenchman; Cement Mason Tender; Curb Setter & Cutter; Form Setter; Grade Checker; Jackhammer Operator; Mason Tender; Mortar Mixer; Mucker (Tunnel & Caisson); Pipelayer; Pump Man (4" & Under); Sewer Bottom Man; Sheeting & Shoring Man; Stonemason Tender; Vibrator Operator; Plasterer Tender; Hand Spiker (Railroad); Concrete & Georgia Buggy Pusher; Deep Trench Work (Over 6'); Cutting & Burning Torch; Hydro-Water Jet Operator; Brick Dropper; Lock Tender; Miner (Tunnel & Caisson); Powderman or Blaster; & Signalperson

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LABO0809A 07/01/2002

	Rates	Fringes
HARRISON & JEFFERSON COUNTIES:		
LABORERS:		
GROUP 1	19.82	5.40
GROUP 2	19.99	5.40
GROUP 3	20.02	5.40
GROUP 4	20.06	5.40
GROUP 5	20.15	5.40
GROUP 6	20.32	5.40
GROUP 7	20.35	5.40
GROUP 8	20.50	5.40
GROUP 9	20.65	5.40
GROUP 10	20.72	5.40

LABORER CLASSIFICATIONS

GROUP 1 - Carpenter Tender; Flagperson; General; Landscaper; & Hazardous Waste Level D

GROUP 2 - Brick Handler; Tender for Brick Mason, Plasterer & Stonemason; Mortarman for Mason & Plasterer; Man Mixing Cement for Cement Finisher; Scaffold Builder; Mortar Mixer Machine Operator; Fork Lift; Hazardous Waste Level C; Fork Truck; Walk Behind Concrete Saw; Form Setter; Epoxy; Paving Brick; Dry

Block; Precast, Lagging, Decorate Blocks & Sand Stone

GROUP 3 - Concrete Buster; Jack Hammer; Air Spade; Chipping Hammer; Air Tamper; Vibrator; Power Buggy; Concrete Saw; Power Saw; Sandblaster; Acetylene Burner; Scuba Diver; Panel Cleaning Machine Operator; Signalman; Power Driven Tool; Air Pump; Air Blow Pipe; Pipelayer & Tender Working in Ditch or Tunnel; Hand Spiker on Railroad & Handling Concrete for Test or Working with Tar, Acid, Creosote & Asbestos, 2" & Under; Skid Steers; Hazardous Waste Level B; Fire Hose; High Pressure Water Hose; Super Sucker; Vacuum Truck & Hose; Core Driller; Drilling For Anchor Bolts; & Dowel Rods & Pins

GROUP 4 - Ditch, Trench, Caisson & Coffer Over 6' deep, Open Top

GROUP 5 - Work Pertaining to or in connection with & Repair of

Stove, Blast Furnace, Basic Oxygen Process Furnace, Basic Oxygen Furnace, Steeple & Stack, Annealing Process Furnace, Kiln, Soaking Pit, Coke Battery on Industrial Work; Hazardous Waste Level A; Ram Cutter; Boiler on Industrial Work & Anything pertaining to, such as Expansion Joints, etc.; Demolition of Stack 50' to 100'; Tunnel; Mucker, including Caisson & Coffer, Horizontal & Underground

GROUP 6 - Demolition of Stack 100' to 150'

GROUP 7 - Miner, including Caisson & Coffer, Horizontal or Underground, Mucking Machine Operator

GROUP 8 - Blasterman & Tender; Bellman & Lancer; Bottom Man in Blast Furnace, Stack, Stove & Dust Catcher; Mud Man & Working with Carbon Brick & Handling Bottom Block on Blast Furnace, Stack, Stove & Dust Catcher

GROUP 9 - Gunnite Nozzleman & Gunnite Machine Operator - Grout Nozzleman & Grout Machine Operator

GROUP 10 - Demolition of Stack over 150'

LABO1015A 05/01/2002

	Rates	Fringes
WAYNE COUNTY:		
LABORERS:		
GROUP 1	19.30	4.40
GROUP 2	19.60	4.40
GROUP 3	19.90	4.40
GROUP 4	19.90	4.40

LABORER CLASSIFICATIONS

GROUP 1 - Building & Construction; Signalman; Flagman; Carpenter Tender; Finisher Tender; Concrete Handler; Utility Construction; Guard Rail Erector; & Hazardous Waste Removal (Level D) Personal Protective Equipment (PPE)

GROUP 2 - Bottom Man; Scaffold Builder; Tunnel; Pipe Layer; Air & Power Driven Tool; Burner on Demolition Work; Swinging Scaffold; Mucker; Caisson Worker; Cofferdam Worker; Powder Man & Dynamite Blaster; Creosote Worker; Form Setter; Plasterer Tender; Hod Carrier; All Confined Space Work; Furnaces; Pickel

Tubs; Acid Pits & Hazardous Waste Removal (Level C) Personal Protective Equipment (PPE)

GROUP 3 - Mason Tender; Mortar Mixer; Stonemason Tender; Skid, Steer Loader; & Hazardous Waste Removal (Level B) Personal Protective Equipment (PPE)

GROUP 4 - Gunnite Operator; & Hazardous Waste Removal (Level A) Personal Protective Equipment (PPE)

LABO1149B 07/01/2002

	Rates	Fringes
BELMONT COUNTY:		
GROUP 1	16.77	8.00
GROUP 2	17.07	8.00
GROUP 3	17.42	8.00

LABORER CLASSIFICATIONS

GROUP 1 - Unskilled; Carpenter Tender; Flagperson; Demolition Worker; Fire Watch; & Landscaper

GROUP 2 - Powderman on Concrete Pump Hose; Semi-skilled Laborer; Scaffold Builder; Grade Checker; Signalperson; Tenders of: Brickmasons, Plasterers, Cement Finishers & Stonemasons; Mortar Mixer; Operators of: Jackhammers, Forklifts, Bobcats, Vibrators, Tampers, Pavement Busters, Chipping & Peening Hammers, Air Siphon & Air Pumps, Concrete Saws, Power Saws, Chain Saws, Motorized Buggies, Post Hole Diggers, Lance and/or Water Blasters & Batch House Scales; Riprap Finisher; Concrete Specialist; Concrete Technician; Sheeter & Shorer; Asphalt Raker; Persons Working with: Mastic Asphalt, Acid Brick, Acid & Creosote; Nozzleman for Gunnite or Sandblasting; Demolition Worker; Ride or Walk Roller Tamper; Deep Ditch Vertical & Manholes 6 ft. or more; Scaffolding Work over 50 ft. (inside or out); Asbestos Abatement; Hazardous Waste Worker; & Environmental Worker

GROUP 3 - Blacksmith; Powderman; Air Track Operator; Pipe Layer; & Burner

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LABO1216A 06/01/2002

	Rates	Fringes
ASHLAND, CRAWFORD, KNOX, MORROW & RICHLAND COUNTIES:		
LABORERS:		
GROUP 1	21.22	4.00
GROUP 2	21.42	4.00
GROUP 3	22.72	4.00

LABORER CLASSIFICATIONS

GROUP 1 - Asbestos Handler; Building & Construction; Carpenter Tender; Concrete Handler; Finisher Tender; Flagperson; Guard Rail Erector; Hazardous Waste (Levels C & D); Signalperson; & Utility Construction Laborer

GROUP 2 - Air & Power Driven Tool; Bottom Man; Burner on Demolition Work; Caisson Worker; Cofferdam Worker; Creosote Worker; Form Setter; Gunite Operator; Hazardous Waste (Levels A & B); Hod Carrier; Mucker; Pipe Layer; Plasterer Tender; Powder

Man & Dynamite Blaster; Swinging Scaffold; & Tunnel Laborer

GROUP 3 - Mason Tender; Mortar Mixer; Scaffold Builder; & Stonemason Tender

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LABO1410A 06/01/2002

	Rates	Fringes
GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
LABORERS:		
GROUP 1	12.93	4.60
GROUP 2	15.93	4.60
GROUP 3	18.45	4.60
GROUP 4	20.15	4.60
GROUP 5	20.65	4.60

LABORER CLASSIFICATIONS

GROUP 1 - Signalman

GROUP 2 - Yardman-Landscaping; Sewer Jet; Unloading of Furniture and Fixtures; Final Clean-Up

GROUP 3 - Building & Construction; Railroad; Asbestos & Hazardous Waste (Levels A, B, C & D); Concrete Crew; Form Setter; Pipelayer; Bottom Man; Burner (Cutting Torch); All Machine & Power Driven Tools; Sandblaster

GROUP 4 - Mason Tender for Bricklayers; Flexicore; Firebrick Tender (Blast Furnaces, Soaking Pits, Stoves & Stacks); Plasterer Tenders

GROUP 5 - Tender Operator

LABO1410B 05/01/2002

	Rates	Fringes
GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
LABORERS:		
Tender for: Bricklayers, Mason & Flexicore	20.15	4.40
Tender Operator	20.65	4.40

PAIN0006U 06/01/2002

	Rates	Fringes
ERIE, HANCOCK, HURON, OTTAWA (Allen, Bay, Bono, Catawba Island, Clay Center, Curtice, Danbury, Eagle Beach, Elliston, Elmore, Erie, Fishback, Gem Beach & Genoa), SANDUSKY, SENECA & WYANDOT COUNTIES:		
PAINTERS:		
Brush & Roller	20.22	6.38
Paperhanging	20.47	6.38
Structural Steel	20.67	6.38
Drywall	20.72	6.38

WINTER REPAINT: Between December 1 to March 31 - 90% JR

$.50 PER HOUR SHALL BE ADDED TO THE RATE OF PAY FOR THE

CLASSIFICATION OF WORK:

While working swingstage, boatswain chair, needle beam and horizontal cable.

While operating sprayguns, sandblasting, cobblasting, high pressure waterblasting (4000 psi), and for automatic taping and finishing tools for drywall.

$1.00 PER HOUR SHALL BE ADDED TO THE RATE OF PAY FOR THE CLASSIFICATION OF WORK:

For the application of catalized epoxy, including latex epoxy that is demed hazardous, lead abatement, or for work or material where special precautions beyond normal work duties must be taken.

For working on stacks, tanks, and towers over 40 feet in height.

PAIN0006W 07/01/2001

	Rates	Fringes
OTTAWA (Excluding Allen, Bay, Bono, Catawba Island, Clay Center, Curtice, Danbury, Eagle Beach, Elliston, Elmore, Erie, Fishback, Gem Beach & Genova) & WOOD COUNTIES:		
PAINTERS:		
NEW COMMERCIAL BUILDING WORK:		
GROUP 1	22.09	7.20
GROUP 2	22.34	7.20
GROUP 3	22.59	7.20
GROUP 4	22.84	7.20
GROUP 5	22.79	7.20
GROUP 6	23.09	7.20

REPAINT IS 90% OF JR

PAINTER CLASSIFICATIONS

GROUP 1 - Brush; Paperhanger; Drywall Taper & Finisher; Spray & Sandblasting Pot Tender

GROUP 2 - Refineries; & All Surfaces 30 ft. or over where material is applied to or labor performed on above ground level (exterior), floor level (interior)

GROUP 3 - Swing Stage & Chair

GROUP 4 - Application of Catalized Epoxies and Waterbased Epoxies of 2 or more component materials; Lead Paint Abatement

GROUP 5 - All Methods of Spray, Paint or any Material Applied with a Pressure Device

GROUP 6 - Solvent Based Material; Sand and Abrasive Blasting

PAIN0012I 06/09/2001

	Rates	Fringes
BUTLER COUNTY:		
PAINTERS:		
GROUP 1	18.66	7.09

GROUP 2	19.16	7.09
GROUP 3	19.41	7.09
GROUP 4	19.66	7.09

PAINTERS CLASSIFICATIONS

GROUP 1: Brush & Roller; Paperhanger; & Drywall Taping

GROUP 2: Spray

GROUP 3: Sandblasting; & Waterblasting

GROUP 4: Lead Abatement

PAIN0012L 06/15/2002

BROWN, CLERMONT, CLINTON & WARREN COUNTIES:

	Rates	Fringes
PAINTERS:		
GROUP 1	21.30	5.10
GROUP 2	21.55	5.10
GROUP 3	21.80	5.10
GROUP 4	22.05	5.10
GROUP 5	22.30	5.10
GROUP 6	23.05	5.10

PAINTER CLASSIFICATIONS

GROUP 1: Brush; Roller; Steam Cleaning; Tanks; Taping & Washing

GROUP 2: Paperhanging and Wall Covering

GROUP 3: Spray

GROUP 4: Sandblasting; Waterblasting; & Hopper Tender

GROUP 5: Hazardous Work; High Work; Elevated Tanks 40 Feet or Above; & Lead Abatement Projects

GROUP 6: Sandblasting, Hopper Tender & Waterblasting Under Hazardous Conditions

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PAIN0012P 11/01/2002

DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, MADISON, PICKAWAY & ROSS COUNTIES:

	Rates	Fringes
PAINTERS:		
Brush; Paperhanger; Roller; & Wall Washing	22.52	6.02
Drywall Sander	22.27	6.02
Structural Steel & Swing Stage	22.82	6.02
Drywall Taper & Finisher	22.92	6.02
Spray	23.02	6.02
Sandblasting; Steamcleaning; Waterblasting (3500 PSI or Over) & Hazardous Work	23.22	6.02

PAIN0012V 05/01/2002

	Rates	Fringes
GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
PAINTERS:		
GROUP 1 - Brush; Roller	20.34	5.33
GROUP 2 - Spackling & Drywall Finishing; Vinyl - Paper Wallcovering	20.69	5.33
GROUP 3 - Swing & Scaffold; Structural Steel; High Tension Electrical Equipment; Hot Pipes	20.75	5.33
GROUP 4 - Spray; Sandblasting; Steam Cleaning; & Lead Paint Abatement	21.09	5.33
GROUP 5 - Steeplejack Work - Church Steeples, Smoke Stacks & Hazardous Work	21.29	5.33
GROUP 6 - Coal Tar	21.84	5.33

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* PAIN0053B 08/01/2002

	Rates	Fringes
MONROE, NOBLE & WASHINGTON COUNTIES:		
GLAZIERS	20.68	3.40

PAIN0093A 06/01/2002

	Rates	Fringes
GUERNSEY, HOCKING, MONROE, MORGAN, NOBLE & WASHINGTON COUNTIES:		
PAINTERS (All Work, except Light Commercial Work):		
Brush; Roller; & Taper	23.73	4.80
Spray; Sandblasting; & Power Tool Under 30' Preparation Confined Areas; & Toxic Material Handlers	25.50	4.80

PAIN0093C 06/01/2002

	Rates	Fringes
GUERNSEY, HOCKING, MONROE, MORGAN, NOBLE & WASHINGTON COUNTIES:		
PAINTERS:		
Separate contracts let which are not in excess of $5,000,000.00 total project construction costs	19.07	4.80

PAIN0356A 07/01/1999

	Rates	Fringes
LICKING, MUSKINGUM & PERRY COUNTIES:		
PAINTERS:		
Brush; Roller; Hopper Tender; & Washing	16.00	3.27
Spray; Steamcleaning; Taping; Paperhanging & Wallcovering (furnishing tools)	16.50	3.27
Sandblasting; Waterblasting	17.00	3.27
Lead Abatement	18.00	3.27
Sandblasting, Hopper Tender & Waterblasting Under Hazardous		

Conditions	19.00	3.27
High Work	19.25	3.27

PAIN0372A 02/01/2001

	Rates	Fringes
DELAWARE, FAIRFIELD, FAYETTE (West of State Rte. #41), FRANKLIN, HOCKING, JACKSON, LICKING, MADISON, MORGAN, MUSKINGUM, PERRY, PICKAWAY, PIKE, ROSS & VINTON COUNTIES:		
GLAZIERS	20.92	5.02+a

FOOTNOTE:
a. 1 Paid Holiday: Labor Day

PAIN0387A 11/25/2001

	Rates	Fringes
ADAMS, BROWN, BUTLER, CLERMONT, CLINTON, FAYETTE (Eastern part), GREENE, HIGHLAND, MIAMI, MONTGOMERY, PREBLE & WARREN COUNTIES:		
GLAZIERS	21.00	4.95

PAIN0406A 06/01/1999

	Rates	Fringes
ASHLAND, CRAWFORD, KNOX, MORROW & RICHLAND COUNTIES:		
PAINTERS:		
GROUP 1 - Drywall, Paperhanger, Wall Coverer & Pot Tender when tending 2 or more Sprayers or Metalizing Workers	18.55	2.00
GROUP 2 - Brush; Cleaner; Roller; & Washer	19.00	2.00
GROUP 3 - Structural Steel; & Hazardous Materials, including Epoxy and/or other materials; Dirty Factory Work; & Lead Abatement	19.50	2.00
GROUP 4 - Riggers on Work more than 30 ft. above base level, includes base level & up work; Spray; & Electrostatic Applications	19.75	2.00
GROUP 5 - Blasting: Sand, Grit, Shot, Water; & Metalizing Workers	20.15	2.00

SWING STAGE, WINDOW JACKS, BOATSWAIN CHAIR, SPIDER, CHERRY PICKER AND OTHER TYPES OF LIFTS - $.25 PREMIUM

PAIN0438A 07/01/2001

	Rates	Fringes
BELMONT, HARRISON & JEFFERSON COUNTIES:		
PAINTERS:		
GROUP 1	20.24	5.34
GROUP 2	20.90	5.34

PAINTER CLASSIFICATIONS

GROUP 1 - Brush; Roll; Drywall Taping; & Spray
GROUP 2 - Special Coatings (Anything thinned by MEK, alcohol,

hot or experimental thinners, coal tar epoxies & any experimental paints); Waterblast; Sandblast; Power Tools; Lead Abatement; Vinyl Hanging; & Bazooga & Banjo Tools for Taping

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PAIN0555A 11/01/2002

	Rates	Fringes
ADAMS, HIGHLAND, JACKSON, PIKE & SCIOTO COUNTIES:		
PAINTERS:		
GROUP 1	19.34	8.22
GROUP 2	20.34	8.22

PAINTER CLASSIFICATIONS

GROUP 1 - Brush; Roller; Taping; & Wallcovering

GROUP 2 - Floor Sanding; Power Tools; Sandblasting; Spray; Steam Cleaning; Pressure Washing; Lead Abatement; Hazardous Waste, Toxic Materials; Epoxy & Two Component Materials

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PAIN0603A 06/01/2001

	Rates	Fringes
COSHOCTON, HOLMES, TUSCARAWAS & WAYNE COUNTIES:		
PAINTERS:		
Brush & Roller	17.20	7.39
Paperhanger	17.30	7.39
Spray	17.70	7.39
Drywall Taper	17.60	7.39
Drywall Taper With Machines	17.95	7.39

Swing Stage, Ladder Jack & Window Jack - $.30 Premium

PAIN0639A 05/01/2002

	Rates	Fringes
SIGN PAINTER & ERECTOR	17.12	4.27+ a+b+c

FOOTNOTES:

a. 7 Paid Holidays: New Year's Day; Memorial Day; July 4th; Labor Day; Thanksgiving Day; Christmas Day & 1 Floating Day

b. Vacation Pay: After 1 year's service - 5 days' paid vacation; After 2, but less than 10 years' service - 10 days' paid vacation; After 10, but less than 20 years' service - 15 days' paid vacation; After 20 years' service - 20 days' paid vacation

c. Funeral leave up to 3 days maximum paid leave for death of mother, father, brother, sister, spouse, child, mother-in-law, father-in-law, grandparent and inlaw provided employee attends funeral

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* PAIN0751H 07/01/2002

	Rates	Fringes
BELMONT, GUERNSEY & HARRISON COUNTIES:		
GLAZIERS	18.73	8.05

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 * PAIN0751K  09/01/2002
                                      Rates           Fringes
JEFFERSON COUNTY

GLAZIERS                               14.49           7.60
-----------------------------------------------------------------

 PAIN0813D  06/01/2001
                                      Rates           Fringes
VINTON COUNTY:

PAINTERS:
 GROUP 1                               20.30           7.00

 GROUP 2                               21.65           7.00
 GROUP 3                               20.85           7.00

           PAINTER CLASSIFICATIONS

 GROUP 1 - Brush & Roller

 GROUP 2 - Spray; Sandblasting; Drywall Finishing & Texturing

 GROUP 3 - Wallcovering & Vinyl; Machine, Toolstand & Stilts
-----------------------------------------------------------------

 PAIN1162A  06/01/2001
                                      Rates           Fringes
COSHOCTON, HOLMES, TUSCARAWAS & WAYNE COUNTIES:

GLAZIERS                               20.03           6.06
-----------------------------------------------------------------

 PAIN1195D  11/05/2002
                                      Rates           Fringes
SCIOTO COUNTY:

GLAZIERS                               23.11           3.85
-----------------------------------------------------------------

 PAIN1920A  05/01/1998
                                      Rates           Fringes
ASHLAND, CRAWFORD, HURON (S. part), KNOX, RICHLAND &
 WYANDOT (E. part) COUNTIES:

GLAZIERS:
 Outside Replacement                   12.08           .51
 Outside All Other Work                12.58           .51
-----------------------------------------------------------------

 PAIN6000E  04/01/2000
                                      Rates           Fringes
ALLEN & AUGLAIZE COUNTIES:

PAINTERS:
 Brush; Roller; & Drywall Taping       17.20           5.30
 Paperhanger                           17.45           5.30
 Spray; Sandblasting; Pressure
  Cleaning & Drywall (Using stilts
  & automatic tools)                   17.95           5.30

 Swing Stage, Chair, Safety Belts, Spiders & Cherry Pickers -
  $ .25 premium
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All Surfaces 40 ft. or over where material is applied to or labor performed on, above ground level (exterior), floor level (interior) - $.50 premium

Applying Coal Tar Products - $1.00 premium

PAIN6000H 05/01/2001

	Rates	Fringes
ERIE (Excluding NW tip to Route #4), & HURON (NE part) COUNTIES:		
GLAZIERS	24.24	8.02

PAIN6000J 09/01/2001

	Rates	Fringes
ALLEN, AUGLAIZE, HANCOCK & WYANDOT (W. part) COUNTIES		
GLAZIERS	14.85	3.50

PAIN6000K 07/01/2001

	Rates	Fringes
ERIE (NW tip of county to Route #4), OTTAWA, SANDUSKY, SENECA, & WOOD COUNTIES		
GLAZIERS	23.53	5.79

PLAS0001A 06/22/1999

	Rates	Fringes
BROWN, BUTLER, CLERMONT, HIGHLAND & WARREN COUNTIES:		
PLASTERERS:		
Pointing & Taping of Drywall Surfaces, Acoustical Finishes on Concrete & Drywall Surfaces	18.40	2.60
All Other Work	21.25	2.60

PLAS0001P 06/01/1998

	Rates	Fringes
ASHLAND, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, HOCKING, KNOX, LICKING, MADISON, MORGAN, MORROW, MUSKINGUM, PERRY, PICKAWAY, RICHLAND, ROSS & WYANDOT (Excluding Tymochtee, Crawford, Ridge & Richland Townships) COUNTIES:		
PLASTERERS:		
On Exterior Insulation Finish Systems	14.60	4.91
All Other Work	17.83	4.87

PLAS0001Q 06/01/1998

	Rates	Fringes
ASHLAND, CRAWFORD, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, HOCKING, KNOX, LICKING, MADISON, MORGAN, MORROW, MUSKINGUM, PERRY, PICKAWAY, RICHLAND, ROSS & WYANDOT (Excluding the townships of Tymochtee, Crawford, Ridge & Richland) COUNTIES:		
CEMENT MASONS	18.03	5.00

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 PLAS0001R  06/01/1998
                                      Rates           Fringes
MONROE, NOBLE & WASHINGTON COUNTIES:

CEMENT MASONS                          17.41           4.93
----------------------------------------------------------------

 PLAS0001S  06/01/1998
                                      Rates           Fringes
MONROE, NOBLE & WASHINGTON COUNTIES:

PLASTERERS                             17.83           4.87
----------------------------------------------------------------

 PLAS0039A  07/01/2002
                                      Rates           Fringes
BELMONT, HARRISON & JEFFERSON COUNTIES:

CEMENT MASONS                          20.73           7.13
----------------------------------------------------------------

 PLAS0039B  07/01/2002
                                      Rates           Fringes
BELMONT, HARRISON & JEFFERSON COUNTIES:

PLASTERERS                             21.13           6.55
----------------------------------------------------------------

 PLAS0132B  06/01/1999
                                      Rates           Fringes
CLINTON, GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:

CEMENT MASONS                          19.18           6.30
----------------------------------------------------------------

 PLAS0132D  06/01/1999
                                      Rates           Fringes
CLINTON, GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:

PLASTERERS                             20.25           6.20
----------------------------------------------------------------

 PLAS0132F  06/01/2001
                                      Rates           Fringes
BROWN, BUTLER, CLERMONT, HIGHLAND & WARREN COUNTIES:

CEMENT MASONS                          19.80           5.50
----------------------------------------------------------------

 * PLAS0132J  06/01/2002
                                      Rates           Fringes
ADAMS, JACKSON, PIKE & SCIOTO COUNTIES:

CEMENT MASONS; PLASTERERS              25.03           8.00
----------------------------------------------------------------

 PLAS0886A  07/01/2002
                                      Rates           Fringes
HANCOCK & WOOD COUNTIES:

CEMENT MASONS                          25.38           8.77
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PLAS0886C 07/01/1999

	Rates	Fringes
ALLEN & AUGLAIZE COUNTIES:		
CEMENT MASONS	20.35	7.00

PLAS0886D 07/01/2002

	Rates	Fringes
ALLEN, AUGLAIZE, HANCOCK & WOOD (Excluding Perry & Bloom Townships) COUNTIES:		
PLASTERERS	25.56	7.22
DRYWALLERS	24.20	7.22

PLUM0042A 07/01/2002

	Rates	Fringes
ASHLAND, CRAWFORD, ERIE, HURON, KNOX, MORROW, RICHLAND & WYANDOT COUNTIES:		
PIPEFITTERS; PLUMBERS; & STEAMFITTERS	23.70	11.50

PLUM0050A 07/01/2002

	Rates	Fringes
HANCOCK, OTTAWA, SANDUSKY, SENECA & WOOD COUNTIES:		
PIPEFITTERS; PLUMBERS; & STEAMFITTERS	28.10	12.20

PLUM0083A 07/01/2002

	Rates	Fringes
BELMONT & MONROE (North of Rte. #78) COUNTIES:		
PLUMBERS & STEAMFITTERS	20.06	15.30

PLUM0094A 11/01/2002

	Rates	Fringes
WAYNE COUNTY:		
PIPEFITTERS & PLUMBERS	23.45	10.32

PLUM0162A 06/01/2002

	Rates	Fringes
CLINTON, FAYETTE, GREENE, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
PIPEFITTERS; PLUMBERS; STEAMFITTERS	25.15	9.27

PLUM0168A 06/01/2002

	Rates	Fringes
MONROE (South of Rte. #78), MORGAN (South of Rte. #78) & WASHINGTON COUNTIES:		
PIPEFITTERS & PLUMBERS	26.08	10.54

PLUM0189A 06/01/2002

	Rates	Fringes
DELAWARE, FAIRFIELD, FRANKLIN, HOCKING, LICKING, MADISON, PERRY,		

PICKAWAY & ROSS COUNTIES:

PIPEFITTERS; PLUMBERS; & STEAMFITTERS	26.50	9.98

PLUM0392A 06/01/2002

	Rates	Fringes
BROWN, BUTLER, CLERMONT & WARREN COUNTIES:		
PIPEFITTERS & PLUMBERS	26.00	8.09

PLUM0495A 06/01/2001

	Rates	Fringes
SHOCTON, GUERNSEY, HARRISON, HOLMES, JEFFERSON, MORGAN (South to State Rte. #78 & from McConnelsville west on State Rte. #37 to the Perry County Line), MUSKINGUM, NOBLE & TUSCARAWAS COUNTIES:		
PIPEFITTERS; PLUMBERS; & STEAMFITTERS	22.73	9.72

PLUM0577A 06/01/2002

	Rates	Fringes
ADAMS, HIGHLAND, JACKSON, PIKE, SCIOTO & VINTON COUNTIES:		
PIPEFITTERS; PLUMBERS; & STEAMFITTERS: Manufacturing Plants, Testing Facilities, Enrichment Plants, Compressor Stations, Power Generating Plants, Coke Plants, Co-Generation Plants, Chemical Plants, Incinerators & Steel Mills	25.28	11.14
All Other Work	22.78	11.14

PLUM0776A 07/01/2002

	Rates	Fringes
ALLEN & AUGLAIZE COUNTIES:		
PIPEFITTERS; PLUMBERS; & STEAMFITTERS	23.94	10.80

ROOF0042A 08/01/2002

	Rates	Fringes
BROWN, BUTLER, CLERMONT & WARREN COUNTIES:		
ROOFERS:		
Roofers	24.15	6.04
Pitch	25.15	6.04

ROOF0044A 05/01/2002

	Rates	Fringes
ERIE, OTTAWA & SANDUSKY COUNTIES:		
ROOFERS	24.23	10.10

ROOF0075A 05/01/1999

	Rates	Fringes
CLINTON, GREENE, HIGHLAND, MIAMI, MONTGOMERY & PREBLE COUNTIES:		
ROOFERS:		
Composition, Damp & Waterproof	19.35	5.42
Slate, Tile & Asbestos	19.57	5.42

ROOF0086A 09/01/2001

	Rates	Fringes
AUGLAIZE, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, HOCKING, KNOX, LICKING, MADISON, MORROW, PERRY, PICKAWAY, ROSS & WYANDOT COUNTIES:		
ROOFERS	20.56	7.40

ROOF0088A 06/01/2001

	Rates	Fringes
ASHLAND, COSHOCTON, CRAWFORD, HOLMES, HURON, RICHLAND, SENECA, TUSCARAWAS & WAYNE COUNTIES:		
ROOFERS	19.95	6.96

ROOF0134A 07/01/2001

	Rates	Fringes
ALLEN, HANCOCK & WOOD COUNTIES:		
ROOFERS	22.60	8.08

ROOF0185A 06/01/2002

	Rates	Fringes
ADAMS, JACKSON, PIKE, SCIOTO & VINTON COUNTIES:		
ROOFERS	23.75	5.60

ROOF0188A 07/01/2002

	Rates	Fringes
BELMONT, HARRISON, JEFFERSON & MONROE COUNTIES:		
ROOFERS:		
Roofers	21.27	6.75
Coal Tar Pitch Waterproofing	21.52	6.75

ROOF0242A 06/01/2002

	Rates	Fringes
GUERNSEY, MORGAN, MUSKINGUM, NOBLE & WASHINGTON COUNTIES:		
ROOFERS	20.94	6.73

SFOH0669A 01/01/2003

	Rates	Fringes
ADAMS, ALLEN, ASHLAND, AUGLAIZE, BELMONT, BROWN, BUTLER, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, GREENE, GUERNSEY, HANCOCK, HARRISON, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON,		

KNOX, LICKING, MADISON, MIAMI, MONROE, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PERRY, PICKAWAY, PIKE, PREBLE, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, TUSCARAWAS, VINTON, WARREN, WASHINGTON, WAYNE, WOOD & WYANDOT COUNTIES:

SPRINKLER FITTERS	28.75	7.60

SHEE0024A 06/01/2001

	Rates	Fringes
ALLEN, AUGLAIZE, BUTLER, CLINTON, GREENE, MIAMI, MONTGOMERY, PREBLE, WARREN & WYANDOT COUNTIES:		
SHEET METAL WORKERS	23.41	9.91

SHEE0024B 06/01/2002

	Rates	Fringes
BROWN, CLERMONT & HIGHLAND COUNTIES:		
SHEET METAL WORKERS	23.27	10.03

SHEE0024G 06/01/2002

	Rates	Fringes
ADAMS, DELAWARE, FAIRFIELD, FAYETTE, FRANKLIN, GUERNSEY, HOCKING, JACKSON, KNOX, LICKING, MADISON, MORGAN, MORROW, MUSKINGUM, NOBLE, PERRY, PICKAWAY, PIKE, ROSS, SCIOTO & VINTON COUNTIES:		
SHEET METAL WORKERS	23.12	11.49

SHEE0033B 07/01/2002

	Rates	Fringes
HANCOCK, OTTAWA, SENECA & WOOD COUNTIES:		
SHEET METAL WORKERS	26.40	11.36

SHEE0033E 06/01/2002

	Rates	Fringes
ASHLAND, COSHOCTON, CRAWFORD, HOLMES, RICHLAND, TUSCARAWAS & WAYNE COUNTIES:		
SHEET METAL WORKERS	23.48	11.05

SHEE0033G 06/01/2002

	Rates	Fringes
ERIE, HURON & SANDUSKY COUNTIES:		
SHEET METAL WORKERS	23.27	9.90

SHEE0033J 07/01/2002

	Rates	Fringes
WASHINGTON COUNTY:		
SHEET METAL WORKERS	23.43	11.73

SHEE0033M 07/01/2002

	Rates	Fringes

BELMONT, HARRISON, JEFFERSON & MONROE COUNTIES:

SHEET METAL WORKERS	22.25	10.99

TEAM0175B 06/01/1999

	Rates	Fringes
WASHINGTON COUNTY:		
TRUCK DRIVERS:		
GROUP 1	18.05	.08+a
GROUP 2	18.15	.08+a
GROUP 3	18.30	.08+a
GROUP 4	18.45	.08+a
GROUP 5	18.70	.08+a
GROUP 6	18.80	.08+a
GROUP 7	18.95	.08+a

FOOTNOTE:
a. $1,072.12 per month

TRUCK DRIVER CLASSIFICATIONS

GROUP 1 - Pick-Up; & Panel

GROUP 2 - Flat Body Material (Straight Jobs); Dump (Up to 5 cu. yds.); Greaser; Washer; Tireman; Mechanic; & Tank (Straight)

GROUP 3 - Dump (5 cu. yds. & over); Semi-Dump; Semi-Trailer (whether Flat, Rack or Pole and hauled or pushed by truck or tractor); Agitator or Mixed (Up to 5 cu. yds.); Tank (Semi); & Monorail

GROUP 4 - Low Boy Trailer; Winch; Fork; Distributor (Front & Back End); Truck Crane; Agitator or Mixer (5 cu. yds. & over); Hydraulic Tail Gate; & Farm Type Tractor

GROUP 5 - Euclid; Dumpster; Turnarocker; Ross Carrier; Athey Wagon or Similar Equipment; A-Frame; Hydrolift;& Dual Purpose

GROUP 6 - Mechanic

GROUP 7 - Master Mechanic (3 or more employed)

TEAM0377A 05/01/1997

	Rates	Fringes
ADAMS, ASHLAND, BROWN, BUTLER, CLERMONT, CLINTON, COSHOCTON, CRAWFORD, DELAWARE, ERIE, FAIRFIELD, FAYETTE, FRANKLIN, GREENE, GUERNSEY, HANCOCK (From the southern boundary of the city of Findlay to the northern boundary of Hancock County), HARRISON, HIGHLAND, HOCKING, HOLMES, HURON, JACKSON, JEFFERSON (South to Short Creek), KNOX, LICKING, MADISON, MIAMI, MONTGOMERY, MORGAN, MORROW, MUSKINGUM, NOBLE, OTTAWA, PERRY, PICKAWAY, PIKE, PREBLE, RICHLAND, ROSS, SANDUSKY, SCIOTO, SENECA, TUSCARAWAS, VINTON, WARREN, WAYNE, WOOD, & WYANDOT COUNTIES:		
TRUCK DRIVERS:		
GROUP 1	16.29	6.22
GROUP 2	16.34	6.22
GROUP 3	16.39	6.22
GROUP 4	16.49	6.22
GROUP 5	16.76	6.22

TRUCK DRIVER CLASSIFICATIONS

GROUP 1 - Asphalt Distributor; Batch; 4- Wheel Service; 4-Wheel Dump; & Oil Distributor

GROUP 2 - Tandem

GROUP 3 - Tractor-Trailer Combination: Fuel; Pole Trailer; Ready Mix; Semi-Tractor; & Asphalt Oil Spraybar Man

GROUP 4 - 5 Axles & Over; & Asphalt Oiler Spraybar Man When Operated From Cab

GROUP 5 - Belly Dump; End Dump; Articulated Dump; Heavy Duty Equipment; Low Boy; & Truck Mechanic

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TEAM0697A 09/01/2000

BELMONT, JEFFERSON (North to Short Creek) & MONROE COUNTIES:

	Rates	Fringes
TRUCK DRIVERS:		
GROUP 1 - Pickup	18.75	6.275
GROUP 2 - Flatbed Material; Dump & Semi-Dump	18.80	6.275
GROUP 3 - Tank (Straight & Semi)	18.83	6.275
GROUP 4 - Semi-Tractor Trailer	18.85	6.275
GROUP 5 - Pole Trailer	18.95	6.275
GROUP 6 - Agitator & Mixer (Up to 5 cu. yds.)	19.03	6.275
GROUP 7 - Euclid; Dumpster; Turnarocker; Ross Carrier; & Athey Wagon	19.08	6.275
GROUP 8 - Agitator & Mixer (Over 5 cu. yds.)	19.11	6.275
GROUP 9 - Lowboy Trailer; Winch; Fork & Distributor (Front & Back End); & Truck Crane	19.38	6.275
GROUP 10 - A-Frame	19.45	6.275
GROUP 11 - Mechanic	19.48	6.275

TEAM0908A 05/18/1997

ALLEN, AUGLAIZE & HANCOCK (From the southern boundary of the city of Findlay to the southern boundary of Hancock County) COUNTIES:

	Rates	Fringes
TRUCK DRIVERS:		
Lowboy	17.45	3.57+a

FOOTNOTE:
a. $61.00 per week

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.
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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