USPS Lexington Main Post Office – HVAC Replacement

Project Manual September 18, 2020

USPS Project Number (FMS): C11386

Eastern Facilities Service Office

Greensboro, NC 27498-1103

000002

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END OF DOCUMENT

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PROJECT

Name:	Lexington MPO HVAC Replacement
Location:	Lexington, VA
FMS Project Number:	C11386

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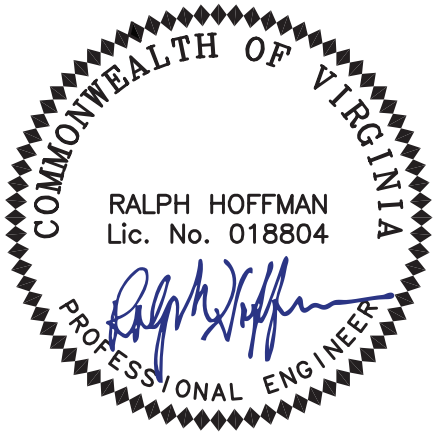

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END OF SECTION

SECTION 011000

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor must provide all material, labor, tools, plant, supplies, equipment, transportation, superintendence, temporary construction of every nature, and all other services and facilities necessary to complete the construction of a postal facility for the Postal Service, including all incidental work described in the contract documents.

B. The scope of work includes, but is not limited to the following:

1. Mechanical Design: The contractor shall decommission and remove the entire existing HVAC system for a complete replacement. The hydronic system includes air-cooled chiller, boiler, compressor, pumps, valves, fittings, expansion tanks, air separators, pneumatic controls, and all accessible piping and insulation. Other equipment includes three chilled water air handling units, fin-tube radiators, cabinet unit heaters, exhaust fans, ductwork, insulation, air terminal devices, and controls. The new HVAC system is inclusive of but not limited to:

    a. Two packaged rooftop units with DX cooling, hot-gas reheat, gas-fired furnace, and economizer mode of operation.
    b. One split system heat pump with supplemental electric heat and economizer mode of operation.
    c. New modular boiler plant for perimeter heating. The hot water system will serve new fin-tube radiators and cabinet unit heaters throughout the facility.
    d. New exhaust fans.
    e. Connect new HVAC to DDC control system.
    f. Provide new ductwork, insulation, and air duct accessories to accommodate new system.
    g. Provide new air terminal devices.
    h. Provide new hydronic piping, insulation, and piping accessories.
    i. Provide minimum of 6 months or longer if needed, of temporary heating and/or cooling as required for the facility during construction.
    j. Startup, test and balance all equipment and air devices.

2. Electrical Design:
    a. Verify existing circuits for all equipment being removed.
    b. Remove all disconnects, raceways, and wiring for existing air handling units and provide new.
    c. Remove all disconnects, raceways, and wiring for chiller and provide new to roof top units.
    d. Remove raceway and wiring for existing HVAC control panel and provide new.
    e. Remove raceway and wiring for duct smoke detectors and provide new.
    f. Remove all disconnects, raceways, and wiring for existing boiler and pumps and provide new for new equipment.
    g. Provide new circuit breakers for air handling units, roof top units, boilers, pumps, and any other equipment being provided. Breakers shall be compatible with existing panelboard.
    h. Provide new disconnects in NEMA 3R enclosures for outdoor roof top units and heat pump.
    i. Provide new disconnects in NEMA 1 enclosures for air handling units, boilers, and pumps.
    j. Update all panel schedules.

3. Miscellaneous Architectural/Structural:
    a. Selective demolition and temporary support for hoist way area in workroom to attic.
    b. Selective demolition in ceiling structure for ductwork penetrations.
    c. Masonry wall penetrations at roof for ductwork.
    d. Miscellaneous structural steel support for new rooftop equipment.
    e. Ceiling patch/repair to accommodate hoist way area and ductwork penetrations.
    f. Miscellaneous structural repairs to accommodate hoist way area and ductwork penetrations.

C. All work shall be in accordance with applicable codes and local regulations that may apply. In case of conflict in or between the Contract Documents and a governing code or ordinance, the more stringent standard shall apply.

1.2 MISCELLANEOUS CONTRACT EXPENSES

A. The Contractor must include all additional fees, as required, in the price proposal.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 011104

CONTRACT DOCUMENTS

PART 1 – GENERAL

1.1 DRAWING LIST

A. The contract drawings consist of the items included, or attached and incorporated by reference, in Section B, The Contract, B. 1500, *Attachments.*

B. 1

Drawing number	Title
T001	Cover Sheet
S101	Partial Framing Plan
S201	General Notes and Details
M001	Cover Sheet
M101	Basement Demolition Plan
M102	1st Floor Demolition Plan
M103	Attic/Roof Demolition Plan
M201	Basement New Work Floor Plan
M202	1st Floor New Work Floor Plan
M203	Attic/Roof New Work Floor Plan
M501	Diagrams and Details
M502	Diagrams and Details
M503	Diagrams and Details
M504	Diagrams and Details
M601	Schedules
M602	Schedules
E001	Electrical Cover Sheet
E101	Basement Demolition Plan
E102	1st Floor Demolition Plan
E103	Attic/Roof Demolition Plan
E201	Basement Power Plan
E202	1st Floor Power Plan
E203	Attic/Roof Power Plan
E601	Schedules and Riser Diagrams

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 – GENERAL

1.1 SCHEDULING WORK

A. Before any of the work is started, the Contractor must confer with the COR and agree on a sequence of procedures: means of access to premises and building; delivery of materials and use of approaches; use of corridors, stairways, elevators, and similar means of communication; and the location of partitions, eating spaces for Contractor's employees, and the like.

B. No work can be done during the holiday mailing season between November 15 and January 5 without written permission from the COR.

C. USPS will have partial occupancy during the construction period and all work and work areas shall be coordinated with USPS.

1.2 CONSTRUCTION PROGRESS CHART

A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Construction Progress Chart*, prepare and submit a progress chart within five (5) days after receipt of the Notice to Proceed to show the principal categories of work corresponding with those used in the Schedule of Values:
   1. The order in which the Contractor proposes to carry on the work.
   2. The date on which it will start each category of work.
   3. The contemplated dates for completion.

B. The chart must be in suitable scale to indicate graphically the total percentage of work scheduled to be in place at any time. At intervals as directed by the COR the Contractor must:
   1. Adjust the chart to reflect any changes in the contract work.
   2. Enter on the chart the total percentage of work actually in place.
   3. Submit six (6) copies of the chart to the Contracting Officer or their designated representative.

C. Submission and approval of the system must be as follows:
   1. A preliminary network defining the Contractor's planned operations must be submitted at the preconstruction conference after receipt of a Notice to Proceed.
   2. The complete network analysis must be submitted within 30 days after receipt of Notice to Proceed.

D. The Contractor must submit at monthly intervals a report of actual construction progress by updating the mathematical analysis. Entering updated information into the mathematical analysis is subject to the approval of the COR.

E. The report must show the activities or portion of activities completed during the reporting period and their total value as a basis for the Contractor's periodic request for payment. Payments made under the terms and conditions of the contract provisions and clauses, including those concerning *Payment (Construction*), must be based on the total value of the activities or of partially completed activities after verification by the COR. The report must state the percentage of the work actually completed and scheduled on the report date and the progress along the critical path in terms of days ahead or behind the allowable dates. If the project is behind schedule, progress along other paths with negative slack must also be reported. The Contractor must also submit a narrative report with the updated analysis, which must include, but is not limited to, a description of the problem areas, current and anticipated delaying factors and their impact, and an explanation of corrective actions taken or proposed.

F. The sheet size of diagrams must be 30 inches x 42 inches. Each updated copy must show the date of the latest revision.

G. Initial submittal and complete revisions must be submitted in three copies.

H. Periodic reports must be submitted in two copies.

I. Network analysis system revisions occurring as a result of modifications or changes in the work must be in accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Network Analysis Systems and Update*.

J. Float or slack is defined as the amount of time between the early start date and the late start date of any of the activities in the network analysis system schedule. Float or slack time is not time for the exclusive use or benefit of either the Postal Service or the Contractor. Extensions of time for performance required under the terms and conditions of the contract provisions and clauses, including those concerning *Changes*; *Differing Site Conditions; Termination for Convenience or Default; Excusable Delays; or Suspensions and Delays* may be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total float or slack along the channels involved at the time that Notice to Proceed was issued for the change.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 013300

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SCHEDULE OF SUBMITTALS

A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning Shop Drawings, Coordination Drawings, *Record "As Built" Drawings, and Schedules;* within 30 days after receiving a Notice to Proceed, the Contractor must complete the Schedule of Submittals, in the format indicated below, in duplicate, listing all items that must be furnished for review and approval by the Postal Service. The schedule must indicate the type of items (such as sample, shop drawings, catalog cut, and so forth) and include the scheduled dates of submittal. In preparing the schedule, adequate time (10 business days or more, exclusive of time in the mails) must be allowed for review and approval and possible resubmittal. Also, the schedule must be coordinated with the approved construction progress chart. The Contractor must revise and/or update the schedule as directed. Such revised schedules must be made available to the COR for monitoring.

B. Within 30 days after receiving a Notice to Proceed, the Contractor must complete and submit to the COR a listing of all subcontractors, including subcontractor name, address, telephone number, fax number and email address. Include an updated list with each progress payment request.

C. Schedule of Submittals Format

Project _____

Contract No. _____

Project Description _____

Spec. Section	Spec. Description	Paragraph Number	*Submittal Type	Date		Action Taken	Assigned Number
				Submittal	Returned		

*Submittal Type:

C – Certificate
CD – Catalog Data
S – Sample
PL – Spare Parts List
SD – Shop Drawing
MM – Maintenance Manual

1.2 SHOP DRAWINGS AND RELATED DATA

A. Submittal of shop drawings, samples and related data must conform to the requirements of the terms and conditions of the contract provisions and clauses, including those concerning, *Record "As Build" Drawings*, and *Samples*. Prior to submittal, the Contractor must stamp the submittal to indicate that it has been reviewed and approved. The Contractor must make any corrections required by the COR. If the Contractor considers any correction indicated on the drawings to constitute a change to the contract drawings or specifications, notice, as required under the terms and conditions of the contract provisions and clauses, including those concerning Changes must be given to the COR. [Four] [ ] prints of all approved shop drawings must be given to the COR. The approval of the drawings by the COR must not

be construed as a complete check but indicates only that the general method of construction and detailing is satisfactory. Approval of the shop drawings does not relieve the Contractor of responsibility for any error that may exist because the Contractor is responsible for the dimensions and design of adequate connections and details and for satisfactory construction of all work. The submission by the Contractor must be accompanied by a transmittal letter of a type approved by the COR.

1. Each shop drawing must have a blank area of 5 by 5 inches, located adjacent to the title block. The title block must display:
   a. Number and title of drawing;
   b. Date of drawing or revision;
   c. Name of project building or facility;
   d. Name of Contractor and (if appropriate) of subcontractor submitting drawing;
   e. Clear identity of contents and location on the work; and
   f. Project title and contract number.
2. All drawings to be provided shall be clear and fully representative of the facility and fixed mechanization work.
3. Drawing files to be in .dwg and .pdf formats. .dwg files to be generated from Autocad revision 12 or other revision level concurred by USPS.
4. Documents other than drawings shall be provided in MicroSoft Word format.
5. Interim project documentation may be provide to USPS electronically
6. All final project documentation shall be provided to the USPS on a single CD or DVD media

1.3 EQUIPMENT ROOM LAYOUT DRAWINGS

A. The Contractor must prepare and submit equipment room layout drawings as required by the technical provisions as well as for areas where equipment proposed for use could present interface or space difficulties. Room layout drawings must be submitted within 40 days after receiving a Notice to Proceed and must conform to the specified requirements for shop drawings. Submittals describing the various mechanical and electrical equipment items that are to be installed in the areas represented by the layout drawings must be assembled and submitted concurrently and must be accompanied by the room layout drawings. Room layout drawings must be consolidated for all trades, to scale, and must show all pertinent structural and fenestration features and other items, such as cabinets, that are required for installation and that affect the available space. All mechanical and electrical equipment and accessories must be shown to scale in the plan and also in elevation or section in their installation positions. Ductwork and piping must be shown.

1.4 MATERIAL, EQUIPMENT, AND FIXTURE LISTS

A. When required by the technical provisions, lists of materials, equipment, and fixtures must be submitted by the Contractor in accordance with the requirements specified for shop drawings. The lists must be supported by sufficient descriptive material, such as catalogs, cuts, diagrams, and other data published by the manufacturer, as well as by evidence of compliance with safety and performance standards, to demonstrate conformance to the specification requirements. Catalog numbers alone are not acceptable. The data must include the name and address of the nearest service and maintenance organization that regularly stocks repair parts. No consideration will be given to partial lists submitted from time to time. Approval of materials and equipment is tentative, subject to submission of complete shop drawings indicating compliance with the contract documents.

1.5 CERTIFICATES OF COMPLIANCE

A. Any certificates required for demonstrating proof of compliance of materials with specification requirements, including mail certificates, statements of application, and extended guarantees, must be signed and submitted 4 copies to the COR at least 10 days before delivery. The Contractor must review all certificates before submissions are made to the COR, to ensure compliance with the contract

specification requirements and to ensure that the affidavit is properly signed. Each certificate must be signed by an official authorized to certify on behalf of the manufacturing company and must contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates must contain the name and address of the testing laboratory and the dates of tests to which the report applies. Certification must not be construed as relieving the Contractor from furnishing satisfactory material if, after tests are performed on selected samples, the material is found not to meet the specific requirements.

1.6 A-E'S REVIEW OF SUBMITTALS

A. When submittals are reviewed by the A-E on behalf of the COR, each submittal must be returned to the Contractor stamped or marked by the A-E in one of the following ways:
   1. A Action: The Contractor is advised that "A Action" means that fabrication, manufacture, or construction may proceed, provided the work complies with the contract documents.
   2. B Action: The Contractor is advised that "B Action" means that fabrication, manufacture, or construction may proceed, provided the work complies with the A-E's notations and the contract documents.
   3. C Action: The Contractor is advised that "C Action" means that no work may be fabricated, manufactured, or constructed and that the Contractor must make a new submittal to the A-E. Any submission marked "C Action" is not permitted on the site.

B. The A-E must return reproducibles stamped "A Action" or "B Action" to the Contractor, who is responsible for obtaining prints of them and for distributing them to the field and to subcontractors.

C. In the case of shop drawings in the form of manufacturers' descriptive literature, catalog cuts, and brochures stamped "A Action" or "B Action," the A-E must return the stamped copies to the Contractor, who is responsible for distributing them to the field and to the subcontractors. If the shop drawings are stamped "C Action," the A-E will return stamped copies to the Contractor, who must submit new shop drawings to the A-E.

D. In the case of samples stamped "A Action" or "B Action," the A-E must return one of the samples to the Contractor. In the case of samples stamped "C Action," the A-E must return all of the submitted samples.

1.7 SPARE PARTS DATA

A. Spare parts data must be submitted in quadruplicate in accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Spare Parts Data*.

1.8 SCHEDULE OF VALUES

A. In accordance with the terms and conditions of the contract provisions and clauses concerning, *Construction Cost Breakdown*, the Contractor must submit a construction cost breakdown using the attached Schedule of Values. When applicable, a separate cost breakdown form must be submitted for each separate building. However, the total cost of site work for the facility must be included in the cost estimate breakdown for the main postal building. The number of items provided on the Systems Construction Cost Estimate Breakdown form are the minimum required. Additional subdivision of these items may be used by the Contractor.

B. Submit the construction cost breakdown after contract award to the COR. A Sample Schedule of Values and Definitions is attached to this Section, as Attachment A.

C. Do not delete items from the Schedule of Values form. However, expand the schedule “Description of Work” as necessary to allow evaluation of work or to make partial payments.

D. If the contract price changes, the Schedule of Values must be revised to reflect the change(s) and forwarded to the COR.

E. A current Schedule of Values must accompany all Contractor Requests for Payment.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

UNITED STATES POSTAL SERVICE

Schedule of Values

Facility: Lexington Main Post Office
Contractor:
Date:

Item	Description of Work		Scheduled Value	Work Completed					Work Remaining	
				Previous Application	This Application		Total Completed and Stored	%	Balance to Finish	Retainage
					Work In Place	Stored Materials				
Division 01	**General Conditions**	%								
1.0	Overhead									
1.1	Profit									
1.2	Bonds & Insurance									
1.3	Bldg. Permits									
1.4	O.& M. manuals									
1.5	Training									
1.6	Subtotal, % only		-	-	-	-	-	-	-	-
Division 02	**Existing Conditions**									
2.0	Demolition									
2.1	Asbestos/Lead Abatement									
Division 05	**Metals**									
5.0	Structural Steel									
Division 07	**Thermal & Moisture Protection**									
7.0	Roofing System									
Division 09	**Finishes**									
9.0	Gypsum Board									
9.1	Painting									
Division 22	**Plumbing**									
22.0	Plumbing									
Division 23	**Heating Ventilating and Air Conditioning**									
23.0	Demolition									
23.1	Duct Cleaning									
23.2	Air Handling Units									
23.3	HVAC Pumps									
23.4	Rooftop Units									
23.5	Unit Heaters									
23.6	Exhaust Fans									
23.7	Diffusers									
23.8	Boilers									
23.9	Controls Systems									
23.10	Ductwork and Duct Insulation									
23.11	HVAC Piping & Insulation									
23.12	Gas Piping									
23.13	Testing & Balancing, & Commissioning Assistance									
23.14	Misc. (itemize)									
23.15	Temporary Heating and Cooling									
Division 25	**Integrated Automation**									
25.0	Building Automation System									
25.1	EEMS Integration									
Division 26	**Electrical**									
26.0	Electrical Power									
26.1	Electrical Lighting									
28.4	Fire Alarm System									
	Subtotal			(without General Conditions)						
Subtotal	**Site Development**			(#2.0, #31.0, #31.1, #32.0 and #33.0) x (100% + #1.7 percentage)						
	Site Improvement			(#3.0, #10.2, #31.2, #32.1, #32.2, #32.3, #33.1 and #33.2) x (100% + #1.7 percentage)						
	Building			(Construction costs not including Sitework cost) x (100% + #1.6 percentage)						
	Total		$ -	$ -	$ -	$ -	$ -		$ -	$ -

SECTION 013543

ENVIRONMENTAL PROCEDURES

PART 1 – GENERAL

1.1 SCOPE

A. This section is required in accordance with the terms and conditions of the contract provisions and clauses, including those concerning Safety & Health Standards, Accident Prevention, Protection of the Environment, Existing Vegetation, Structures, Utilities and Improvements, and Handling Asbestos and other Hazardous Materials. The work covered by this section consists of furnishing all labor, material, and equipment and performing all work required for compliance with environmental regulations and preventing pollution during, and as a result of, construction operations under this contract, in addition to those measures set forth in other technical provisions of these specifications.

B. The Contractor and subcontractors must comply with all applicable federal, state and local laws and regulations related to the environment, health and safety.

1.2 NOTIFICATION

A. The Contractor must, after receiving a notice of noncompliance with the foregoing provisions, immediately take corrective action. The notice, when delivered to its Contractor or its authorized representative at the site of the work, is deemed sufficient for this purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost because of any such stop orders may be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is subsequently determined that the Contractor was in compliance and the Contractor demonstrates that it is otherwise entitled to an extension of time, excess costs or damages, under the applicable terms and conditions of the contract provisions and clauses.

1.3 ENVIRONMENTAL REGULATORY COMPLIANCE

A. Within 30 days after receiving the notice to proceed or not less than 15 days prior to commencing on-site work, the Contractor must submit any environmental documents that are required by federal, state or local environmental regulations. Plans must be approved by the COR prior to commencing on-site work and must describe and include, but is not limited to, the following

1. Erosion Control and Stormwater Management Plan that describes erosion control methods, surface drainage, storm water permitting requirements, and if applicable, protection of site wetlands and/or compliance with wetland permits. This must ensure any federal, state or local permitting requirements for site preparation, erosion control or surface drainage are met.
2. Landscape Management and Protection Plan that ensures any site-specific beneficial landscaping requirements are met. The plan shall describe the prevention and restoration of landscape damage, temporary roads and embankments, and post construction cleanup as prescribed in the terms and conditions of the contract provisions and clauses, including those concerning *Protection of the Environment, Existing Vegetation, Structures, Utilities and Improvements*.
3. Waste Minimization and Management Plan must describe how natural resources potentially impacted by construction will be protected or managed; construction wastes will be stored and disposed of or recycled; and pollutants associated with building materials will be controlled. The waste minimization and management section of the plan

must also list materials and construction debris to be recycled, and address the disposal of solid and hazardous wastes and materials, including asbestos and lead-based paint. It must also include tables applicable to the reclamation of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) in accordance with 1.4 (B) below.

1.4 ENVIRONMENTAL SITE CONTROLS

A. Location of Hazardous Materials: The location of the Contractor's temporary storage of any hazardous materials and/or wastes must be appropriately marked and included in the health and Safety Plan (see Section 1.5 below).

B. Refrigerant Recovery, Recycling, and Disposal: Any work involving the replacement or repair of equipment containing refrigerant shall meet the following requirements:
   1. Recover and recycle or dispose of refrigerant from equipment according to 40 CFR 82 and local regulations.
   2. The work shall be completed by a certified refrigerant recovery technician, per 40 CFR 82 and local regulations.
   3. Provide a statement signed by the certified refrigerant recovery technician that the work was completed per 40 CFR 82 and local regulations. Include the name and address of technician and date refrigerant was recovered.

C. Post-construction Cleanup or Obliteration: The Contractor must remove and properly dispose of all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, excess or waste materials, or any other vestiges of construction as directed by the COR. No separate or direct payment may be made for post-construction cleanup and all associated costs must be considered included in the contract price.

D. Historical and Archeological: Monuments, markers, and works of art must be protected. Items discovered that have potential historical or archeological interest must be preserved. The Contractor must leave the archeological find undisturbed and must immediately report the find to the COR so that the proper authority may be notified.

E. Dust Control: The Contractor must keep the site free from dust in accordance with applicable federal, state and/or local regulations.

F. Noise Minimization: The Contractor must perform demolition and construction operations to minimize noise including conducting work during less sensitive hours of the day in accordance with applicable noise control regulations.

1.5 HEALTH AND SAFETY

A. Prior to commencing on-site work, the Contractor must submit an Occupational Safety and Health Administration (OSHA) Emergency Action Plan (EAP) to the Contracting Officer to demonstrate compliance by the Contractor and subcontractors with applicable OSHA regulations. If the Contractor is not required by OSHA to develop a written EAP, i.e. if 10 or fewer are employed for the construction project or any other specific regulations identified by OSHA, then the Contractor shall submit to the Contracting Officer a signed letter stating the Contractor shall meet OSHA's EAP requirements in a verbal communication to all employees.

B. The Postal Service has provided a *Safety and Health Guide for Contractors*, as Attachment A to this section. Prior to commencing on-site work, Contractor must read the *Safety and Health Guide for Contractors* and must sign the attached Certificate of Understanding acknowledging and accepting the requirements stated therein.

C. Prior to commencing on-site work, the Contractor must submit a project-specific Project Safety Plan to the Contracting Officer. The plan must include, but is not limited to, hazard communication, labeling, emergency response and preparedness and training.

D. Copies of Material Safety Data Sheets (MSDSs) for any hazardous material(s), as defined by OSHA's Hazard Communications Standard, must be included whenever such materials arrive on-site. MSDSs must be kept together and maintained centrally on-site through to project completion. Provide a copy of each MSDS in the Operating and Maintenance Manual. The use of asbestos containing materials, in excess of one percent as defined by US Environmental Protection Agency regulations, is prohibited in the construction of this project. Provide an executed copy of the "Certificate of Asbestos and Lead-Based Paint (New Work)" in the Operating and Maintenance Manual and include a copy with the final payment request.

E. The use of lead-based paint is prohibited in the construction of this project.

F. The use of lead-containing solder for plumbing and plumbing fixtures is prohibited in the construction of this project.

G. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Asbestos Free and Lead-Based Paint Free Certification*, the Contractor must sign and submit to the Contracting Officer the attached "Certification of Asbestos and Lead-Based Paint" for this project. The signed certificate is required to be included in the final payment request.

H. Do not use any of the USPS targeted chemicals (see regulated and prohibited materials identified under Safety and Health and related environmental requirements).

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

Safety and Health Guide for Contractors

Certificate of Understanding

This *Safety and Health Guide for Contractors* was developed by the Postal Service to provide guidance for contractors hired to perform repair, alteration, renovation, demolition, equipment installation, and other work requiring access to postal-owned or -leased property.

Distribution

A copy of this Certificate of Understanding should be signed by the Contractor's representative at the post award orientation conference or before the commencement of work. A copy of this guide should be readily accessible where the work is being performed. The contracting officer's representative (COR) should thoroughly brief the Contractor's representative on the Contract Safety and Health Requirements contained herein.

Contractor's Verification Statement

As a representative of _____ (Contractor's name), I have received the *Safety and Health Guide for Contractors* prepared by the Postal Service. As the Contractor's representative, I understand and accept the requirements contained herein, and I have reviewed each of the required sections of the guide with the COR and/or the designated Postal Service representative. I agree to review the contents of this guide with all subcontractors hired to perform work on postal property.

Contractor's Representative

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Designated Postal Service Representative

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Safety Representative (If Required by COR)

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Postal Service CO, COR, or Project Manager

Printed Name: _____ Contact Number: _____

Signature: _____ Date: _____

Maintain a copy of this signed form in the Postal Service and Contractor's project files.

Safety and Health and Related Environmental Requirements

The Contractor is required to meet all applicable OSHA, federal, state, and local safety, health, and related environmental requirements in addition to the US Postal Service requirement listed in this table.	
Issue	**Postal Requirements**
Asbestos	*Review of Facility Asbestos Survey:* Before any building maintenance, equipment installation, renovation, alteration, demolition, or other project begins, determine whether ACBM will be disturbed. Proper Work Practices: If ACBM is present, follow proper control procedures and work practices. *Consultation With Facility Asbestos Coordinator:* Consult with the facility manager or his or her designee before the start of any work likely to disturb ACBM. Disturbance means activities that crumble or pulverize ACBM or presumed asbestos-containing material (PACM) or generate visible debris. Operations may include drilling, abrading, cutting a hole, pulling cable, and crawling through tunnels or attics and spaces above the ceiling where asbestos is actively disturbed or asbestos-containing debris is actively disturbed. *Asbestos Work Authorization:* You must have an approved Form 8210, *Work Authorization - Asbestos,* before work begins within any building containing asbestos.
Barricades, Barriers, and Warnings	Your barricades must meet the OSHA requirements. In addition, you assume control of your work area during your activities unless otherwise specified in writing by the contracting officer (CO) or contracting officer's representative (COR).
Confined Spaces	Confined space work must meet the OSHA requirements. You must have a comprehensive confined space program that includes a written program, employee training, entry and testing equipment, and rescue capabilities. If you require access to confined space requiring a permit, then the trained, designated Postal Service representative must review and approve the project and permit. Entry into other confined spaces must be in accordance with OSHA regulations.
Electrical Work	Lock or rope off work areas involving exposed energized equipment or have an attendant present to prevent accidental contact by unqualified people. Refer to the Barricade section of this guideline for additional information.
Elevated Work and Fall Protection	Follow strictly the applicable OSHA fall protection requirements.
Excavation	All excavations 4 feet or more in depth must be properly shored or sloped and meet all OSHA requirements. Before any digging or drilling commences, inform the Postal Service COR and call Dig Safe or its local equivalent to determine whether any underground utilities are located in the work area. Submit documentation that these notifications have been performed. You must not begin digging or drilling until you have verified that underground utilities have been identified and are properly marked so that work may be accomplished in a safe manner.
Fire Protection	Do not block, remove, or otherwise prevent Postal Service fire extinguishers from being immediately accessible and usable. If a system must be impaired by a scheduled shutdown, notify the appropriate Postal Service representative and do not proceed without Postal Service authorization.
Hazard Communication	Inform the Postal Service before any chemicals are used. Before materials are brought on site, provide material safety data sheets (MSDSs) and an inventory of materials. For projects that are anticipated to use substantial quantities of hazardous materials, you may be required to provide a routing, storage, and waste disposal plan. Upon request, the Postal Service will make available to you MSDSs for hazardous materials the Postal Service uses in the Contractor work area.
Hazardous Materials	Follow all OSHA requirements regarding hazardous materials. Hazardous materials include, but are not limited to, flammable and combustible liquids, gasoline, diesel fuel, motor oil, lubricating oil, hydraulic oil, corrosive cleaners, and battery acid. Provide secondary containment for all containers of liquids that are over 5 gallons in capacity. Immediately report all hazardous material releases ("spills"), regardless of how small or where they occur, to the designated Postal Service representative. Releases include solids, liquids, and gases.
Hot Work	Do not begin any hot work until a Postal Service qualified person has completed and signed a Postal Service Hot Work Permit. The permit will be valid for only a single work shift. You must display the permit at the work site. You are prohibited from performing hot work (a) when the Postal Service has not authorized it, (b) in locations in which fire protection systems have been impaired, (c) in the presence of explosive or flammable atmospheres, or (d) in locations were large quantities of flammable

	and combustible materials are unprotected.
Powered Industrial Trucks	Powered industrial trucks and other mobile equipment must follow all traffic rules of the postal facility. The maximum speed limit for in-plant powered vehicles is 5 miles per hour. Many work areas have posted speed limits that you must strictly follow. Perform refueling only in authorized locations following safe procedures. As a general rule, the Postal Service does not allow gas- or diesel-powered industrial equipment inside postal facilities. Coordinate exceptions to the rule through the servicing safety office.
Ladders	Strictly follow all OSHA requirements regarding ladders. Barricade the ladder use area to prevent contact with mobile equipment and employees.
Lead-Based Paint	*Review of Facility Lead Survey:* Before any construction, alterations, and/or repair activities begin, determine whether LBP will be disturbed. If the painted surface has not been tested, you must have it tested before beginning any activities that could potentially disturb LBP. *Proper Work Practices:* If LBP is present, follow proper control procedures and work practices. *Consultation With Facility Manager:* Consult with the facility manager or his or her designee before the start of any work likely to disturb LBP. Examples of activities that may affect LBP include paint removal by scraping, sanding, power tools, or heat guns; alterations that include removing drywall, structural steel, or other building materials coated with LBP; welding, cutting, or other hot work on coated metal surfaces; abrasive blasting of mail boxes and other equipment; and moving or cleaning of abrasive blasting enclosures.
Lockout/Tagout	Provide a copy of your lockout/tagout procedures, which must meet or exceed the OSHA Lockout/Tagout standard. You will be given access to and must review the Postal Service lockout/tagout program. If you encounter a Postal Service lockout/tagout device that prevents the continuation of work, do not make any attempts to remove, tamper with, or bypass the devices. Contact a Postal Service Maintenance official and make arrangements to have the lockout device removed in accordance with Postal Service lockout removal policies.
Machinery and Equipment	Postal facilities use state-of-the-art mail handling machinery, some of which may operate automatically. Hazards may include, but are not limited to, moving parts and power transmission apparatus, pinch points, electrical contact, and hot surfaces. Do not use machine surfaces as work platforms. Contact the designated Postal Service representative concerning facility machinery.
Personal Protective Equipment	Before beginning work, evaluate the work area for hazards, determine whether contract employees will be required to use personal protective equipment (PPE) to protect themselves from these hazards, and document the hazard assessment. Wear the PPE required by the postal facility in which you are working, regardless of your perception of hazard potential.
Regulated And Prohibited Materials	*Pesticides.* The Postal Service has restricted the use of pesticides. Obtain prior approval of the district environmental compliance coordinator for special cases that may require the use of pesticide treatments. *Chemical Prohibition.* Adhere to the Postal Service Hazard Communication Program and chemical prohibition policies. Do not use on postal property any of the chemicals prohibited by EPA unless a Postal Service person authorizes its use (each of these chemicals must be authorized separately). The USPS Office of Sustainability can supply the list. *Asbestos-Free Products.* Install no asbestos-containing products or materials in postal facilities. *Lead.* Apply no lead-based paint in postal facilities.
Scaffolding	Follow strictly the applicable OSHA scaffolding requirements. Provide adequate barrier protection around the scaffolding to prevent hazards to postal workers.
Walking and Working Surfaces	If the project requires temporary modifications to the means of egress, inform the designated Postal Service representative before performing such actions, provide appropriate alternative means of egress, and communicated these to all employees.

Emergency Procedures

Preparations for Emergency	Be prepared for emergency situations. Ensure that emergency telephone numbers are site specific, readily available, easily read, and communicated to all employees. Train and authorize employees to implement emergency procedures.
Medical Emergencies	Have procedures and medical supplies to provide emergency medical services for your own personnel. Determine how to contact emergency medical services before work begins, and have on-site capabilities to contact such services immediately.
Fires	See Fire Protection above. In the event of a fire, you must: - Immediately remove personnel from the area or building following Postal Service evacuation procedures. - Immediately contact the nearest postal employee and inform him or her of the fire. You may also activate an emergency alarm in the area. If no postal employees are on-site, immediately contact the local fire department. Personnel trained in the use and limitations of fire extinguishers may attempt to extinguish the fire if it is safe to do so.
Chemical Releases	See Hazardous Materials above. If the event of a hazardous material release, you must: - Immediately remove personnel from the area or building following Postal Service evacuation procedures. - Immediately contact the designated Postal Service representative and inform him or her of the release. You may also activate an emergency alarm in the area. If no postal employees are on-site, immediately contact the local fire department. Contractor personnel should not respond to the release unless specifically trained and protected to perform hazardous material response.
Power Outages	In the event of a power outage, you must: - Immediately stop work and assemble for a head count and possible facility egress. - Inform all contract employees that equipment may automatically restart when power resumes. - Immediately contact the designated Postal Service representative and inform him or her of the status of contract work and personnel head count. Relay at this time all hazards created due to the power outage. When power resumes evaluate the status of operations that were being performed relative to hazard potential. For example, the interruption of ventilation in confined spaces may generate atmospheric hazards.
Accident Investigation and Reporting	As soon as is practical after an accident, investigate and document an accident investigation. The documentation must describe the incident and identify the causes and the corrective actions that will prevent future incidents. Report all accidents, whether or not they result in injury. Give the written report to the Postal Service COR within 24 hours of the accident or incident.

Certificate of Asbestos and Lead-Based Paint

(New Work)

To: Contracting Officer, United States Postal Service

Subject: Certification for new construction

Postal facility name: _____

Postal facility address: _____

Certification for new construction:
This Contractor/Owner hereby certifies that no asbestos-containing material in excess of 1 percent as defined by applicable US Environmental Protection Agency regulations, and no lead-based paint has been furnished or installed at the referenced project.

Contractor/Owner name: _____

Signature: _____

Address: _____

_____

Telephone: _____ Date executed: _____

The penalty for making a false statement is prescribed by 18 USC 1001.

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SECTION 014000

QUALITY REQUIREMENTS

PART 1 – GENERAL

1.1 CONTRACTOR QUALITY CONTROL

A. Contractor Quality Control: The Contractor is responsible for the overall quality of all its own work and the work performed by their subcontractors working under this contract. The quality of any part of the work installed must not be less than that required by the technical divisions of this specification. If the COR determines that the quality of work does not conform to the applicable specifications and drawings, the Contractor will be advised in writing of the areas of nonconformance, and within 7 days the Contractor must correct the deficiencies and advise the COR in writing of the corrective action taken.

B. Noncompliance with Quality Control Requirements: Failure of the Contractor to comply with the above requirements may be cause for termination for default as defined in the terms and conditions of the contract provisions and clauses, including those concerning, *Termination for Convenience or Default*, of the general contract clauses.

1.2 SUBMITTALS

A. Prior to the start of on-site work, the Contractor must submit to the Contracting Officer a Contractor Quality Control Plan that includes the following information:
   1. Quality Control Organization: In chart form, showing relationship of Quality Control organization to other elements of Contractor's organization.
   2. Names and qualifications of personnel in Quality Control organization, including Contractor Quality Control Representative, inspectors, Independent Testing and Inspection Laboratory, and Independent HVAC Test and Balance Agency.
   3. Procedures for reviewing coordination drawings, shop drawings, certificates, certifications, or other submittals.
   4. Testing and inspection schedule, keyed to Construction Schedule, indicating tests and inspections to be performed, names of persons responsible for inspection and testing for each segment of work including preparatory, initial, and follow-up.
   5. Proposed forms to be used including Contractor's Daily Report, Contractor Test and Inspection Report and Non-Compliance Check-Off List.

B. INDEPENDENT TESTING AND INSPECTION LABORATORY: Submit the following.
   1. Name.
   2. Address.
   3. Telephone number.
   4. Names of full time registered engineer.
   5. Responsible officer.
   6. Copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by inspection.

1.3 QUALITY CONTROL PROCEDURES

A. Monitor quality control over Contractor staff, subcontractors, suppliers, manufacturers, products, services, site conditions, and workmanship.

B. Comply fully with manufacturer's published instructions, including each step in sequence of installation.

C. Should manufacturer's published instructions conflict with Contract Documents, request clarification from COR before proceeding.

D. Comply with specified standards as a minimum quality for work, except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons who are thoroughly qualified and trained in their respective trade, to produce workmanship of specified quality.

F. Perform tests required by governing authorities having jurisdiction and utilities having jurisdiction.

1.4 TESTING AND INSPECTION LABORATORY SERVICES

A. Selection and Payment:
   1. The Contractor shall pay for services of an Independent Testing and Inspection Laboratory to perform specified testing and inspection.
   2. Employment of Independent Testing and Inspection Laboratory in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

B. Quality Assurance:
   1. Comply with requirements of all applicable ASTM standards.
   2. Laboratory: Authorized to operate in State in which Project is located.
   3. Laboratory Staff: Maintain a full time registered engineer on staff to review services.
   4. Testing Equipment: Calibrated at reasonable intervals with devices of and accuracy traceable to either National Bureau of Standards or accepted values of natural physical constraints.

C. Laboratory Responsibilities. Contractor shall ensure the Laboratory has the following responsibilities and limits on authority:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at Project site. Cooperate with COR and Contractor in performance of services.
   3. Perform specified sampling, testing, and inspection of Products in accordance with specified standards.
   4. Determine compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Contractor Quality Control Representative and COR of observed irregularities or non-conformance of work or Products.
   6. Submit one copy of all test results directly to the COR.
   7. Perform additional tests as required by COR.
   8. Attend appropriate preconstruction meetings and progress meetings.

D. Limits on Authority. Contractor shall ensure the Laboratory has the following limits on authority:
   1. Laboratory may not release, revoke, alter, or expand on requirements of Contract Documents.
   2. Laboratory may not approve or accept any portion of work.
   3. Laboratory may not assume any duties of Contractors.
   4. Laboratory has no authority to stop work.

1.5 CONTRACTOR FIELD INSPECTION AND TESTING

A. Contractor: Test and Inspect work provided under this Contract to ensure work is in compliance with Contract requirements. Required tests and inspections are indicated in each individual Specification Section.

B. Preparatory Inspection: Performed prior to beginning work and prior to beginning each segment of work and includes:

1. Review of Contract requirements.
2. Review of shop drawings and other submittal data after return and approval.
3. Examination to assure materials and equipment conform to Contract requirements.
4. Examination to assure required preliminary or preparatory work is complete.

C. Initial Inspection: Performed when representative portion of each segment of work is completed and includes:
1. Performance of required tests.
2. Quality of workmanship.
3. Review for omissions or dimensional errors.
4. Examination of products used, connections and supports.
5. Approval or rejection of inspected segment of work.

D. Follow-Up Inspections: Performed daily, and more frequently as necessary, to assure non-complying work has been corrected.

E. Testing and Inspection: Perform testing and inspection in accordance with requirements in individual Specification Sections.

1.6 CONTRACTOR'S DAILY REPORT

A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Performance and Superintendence of Work by Contractor*, the Contractor shall submit daily report to COR, for days that work was performed. Include the following information:
1. Date, weather, minimum and maximum temperatures, rainfall, and other pertinent weather occurrences.
2. Daily workforce of Contractor and subcontractors, by trades.
3. Description of work started, ongoing work, and work completed by each subcontractor.
4. Coordination implemented between various trades.
5. Approval of substrates received from various trades.
6. Nonconforming and unsatisfactory items to be corrected.
7. Remarks, to include at a minimum, any potential delays, schedule changes, workplace incidents or other items of note. However, nothing reported herein shall relieve the Contractor of the separate responsibility under other terms and conditions of the Contract provisions and clauses to provide specific notice to the Contracting Officer,

1.7 CONTRACTOR'S TEST AND INSPECTION REPORTS

A. Prepare and submit, to COR, a written report of each test or inspection signed by Contractor Quality Control Representative performing inspection within 2 days following day inspection was made.

B. Include the following on written reports of inspection:
1. Cover sheet prominently identifying that inspection "CONFORMS" or "DOES NOT CONFORM" to Contract Documents.
2. Date of inspection and date of report.
3. Project name, location, solicitation number, and Contractor.
4. Names and titles of individuals making inspection, if not Contractor's Project Field Superintendent.
5. Description of Contract requirements for inspection by referencing Specification Section.
6. Description of inspection made, interpretation of inspection results, and notification of significant conditions at time of inspection.
7. Requirements for follow-up inspections.

1.8 NON-COMPLIANCE CHECK-OFF LIST

A. Maintain check-off list of work that does not comply with Contract Documents, stating specifically what is non-complying, date faulty work was originally discovered, and date work was corrected. No requirement to report deficiencies corrected same day it was discovered. Submit copy of Non-Compliance Check-Off List of non-complying work items to COR on a weekly basis.

1.9 COMPLETION AND INSPECTION OF WORK

A. Prior to final acceptance by Contracting Officer, submit a certification signed by Contractor to Contracting Officer stating that all work has been inspected and all work, except as specifically noted, is complete and in compliance with Contract Documents.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

A. The Contractor must provide all temporary facilities and services required to complete the work and to comply with OSHA and other applicable regulations.

B. The Contractor must maintain temporary facilities in a proper, safe, operating and sanitary condition for the duration of this Contract. Upon completion of this Contract, all such temporary work and facilities shall be removed in their entirety and the premises will be restored to its prior condition.

1.2 PROJECT SIGN

A. The Contractor must provide and maintain a construction project sign at the location directed by the COR. The sign must conform to the Construction Sign as detailed in the Contract drawings. The information needed to complete the wording on the sign is provided by the COR and will be essentially as shown on the cover of the specification. The sign must be erected within 15 days after receiving a Notice to Proceed. The sign will remain the property of the Contractor and must be removed upon completion of the work and the premises will be restored to its prior condition.

B. Construction Site Sign:
   1. Silk-screened, painted or pressure-sensitive vinyl letters applied to Medium Density Overlay plywood sign.
   2. Red: Match Benjamin Moore OP-67.
   3. Blue: Match PPG 7062 Federal Blue.
   4. White background.

C. The Contractor must construct and erect a minimum of two hard hat signs at locations designated by the COR. The signs must be erected prior to the commencement of on-site work.

1.3 BULLETIN BOARD

A. A weatherproof bulletin board, not less than 36 inches wide and 30 inches high, with hinged glass door must be provided adjacent to, or mounted on, the Contractor's project office. If adjacent to the office, the bulletin board must be securely mounted on not less than two posts. The bulletin board and posts must be painted or have approved factory finish. The bulletin board must be easily accessible at all times and must contain wage rates, equal opportunity notice, and other items required to be posted.

B. The Contractor must maintain the bulletin board in good condition throughout the life of the project. The bulletin board will remain the property of the Contractor and upon completion of the project must be removed from the site and the premises will be restored to its prior condition.

1.4 CONSTRUCTION-USE UTILITIES

A. The Contractor must arrange with the local utility companies for gas, water, and electricity required for construction under this project and must pay all costs in connection with them. The Contractor must, at its own expense, make all temporary connections and install distribution lines. All temporary lines must be maintained by the Contractor in a manner satisfactory to the COR and must be removed by the Contractor in like manner before final acceptance of the construction.

1.5 TEMPORARY ELECTRICITY

A. Costs: The Contractor must make arrangements, and install equipment, wiring, switches, and outlets necessary to provide adequate supply for lighting and power for construction purposes. The Contractor must pay for power used during construction and for removal of all temporary equipment.

B. Service Required: The Contractor must provide temporary electric power throughout the construction period so that power can be secured at any desired point with no more than a 100-foot extension cord; power centers for miscellaneous tools and equipment used in the construction work (not less than one per 2,000 square feet of floor space, consisting of a weatherproof distribution box with a minimum of four 20-amp, 120-volt grounded outlets with a circuit breaker protection for each outlet); lighting for safe and adequate working conditions throughout building (at least 1/4 watts of incandescent lighting per square foot, with a socket voltage of at least 110 volts and using 100 watt lamps minimum); power for construction site offices and other temporary storage and construction building; and power for testing and checking equipment welding units.

C. Safety: The Contractor must provide and maintain lights and signs to prevent damage or injury and must illuminate all hazardous areas. Safety lights must be kept burning from dusk to dawn.

D. Requirements of Regulatory Agencies: The Contractor must comply with the National Electrical Code, applicable local codes, and utility regulations.

E. Use of Permanent System: The Contractor must regulate any part of the permanent electrical system that is used for construction purposes in order to prevent interference with safety and with the orderly progress of the work. The Contractor must leave permanent electrical services in a condition as good as new.

F. Materials: The materials may be new or used but must be adequate in capacity for the purposes intended and must not create unsafe conditions or violate the requirements of applicable codes. At the Contractor's option, patented specialty materials may be used if UL-approved.

G. Conductors: The Contractor must use wire, cable, or busses of appropriate type, sized in accordance with the National Electrical Code for the applied loads. Use only UL-approved wire.

H. Equipment: In compliance with NEMA standards, the Contractor must provide an appropriate enclosure for the environment in which the equipment is used.

I. Installation: The Contractor must provide all required facilities, including transformers, conductors, poles, conduits, raceways, fuses, switches, fixtures, and lamps, located so as to avoid interference with cranes and materials-handling equipment, storage areas, traffic areas, and work under other contracts. The Contractor must install all work to have a neat and orderly appearance and to make it structurally sound throughout. The Contractor must maintain it to give continuous service and to provide safe working conditions. The Contractor must modify the service as required by the progress of the job.

J. Removal: The Contractor must remove all temporary equipment and materials upon completion of construction, repair all damage caused by the installation, and the premises will be restored to its prior condition.

1.6 TEMPORARY HEATING AND VENTILATION

A. The Contractor must provide cold weather protection and temporary heat and fuel as required to carry on the work expeditiously during inclement weather, protect all work and materials against damage from dampness and cold, dry out the building, and provide suitable working conditions for the installation and curing of materials until final acceptance by the Contracting Officer. The Contractor must refer to requirements in detailed specifications for temperatures to be provided and maintained for installation and curing of work under the various trades.

B. The Contractor must provide temporary heat consisting of smokeless heating appliances satisfactory to the COR. The Contractor must furnish and pay for all necessary fuel and attendants in any trade and must maintain temporary heat at temperatures adequate for the intended purpose.

C. When the permanent heating system is operable and the Contractor elects to use it, the Contractor must provide all fuel, labor, materials, services, equipment, and attendants necessary to operate the permanent heating system for temporary heat and to maintain a minimum temperature as specified in the terms and conditions of the contract provisions and clauses, including those concerning *Heat*. If the permanent system is used to provide temporary heating and ventilation, the Contractor must replace all filters and restore the system to a condition satisfactory to the COR.

1.7 SANITARY PROVISIONS

A. The Contractor must provide and keep in neat and sanitary condition conveniences and accommodations for the use of the construction personnel necessary to comply with the requirements and regulations of the local department of health and of other bodies having jurisdiction.

B. The Contractor shall be permitted to use the existing restroom facilities within the work area. If the facilities are used, the contractor must clean and replace any item damaged during construction. The facilities shall be left in the condition equal to when project started. Photo document prior to construction commencement.

1.8 APPROACHES AND EXITS

A. The Contractor must provide all necessary approaches and exits required to properly execute the work.

B. In connection with these, the Contractor must provide for temporary drainage to keep the site free from standing water at all times.

1.9 PROJECT PHOTOS - Required on construction contracts that exceed $10,000.00. The number of photographs, and their content, shall be appropriate to the Contract Scope of Work, with their intended purpose being to illustrate, generally, the work in place for which this payment application applies.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 016000

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the terms and conditions of the contract provisions and clauses, including those concerning *Optional Materials or Methods (Construction)*, *Materials and Workmanship*, *Information On "Equal" Products* and *Brand Name or Equal.*

B. Provide Products that comply with Contract Documents, which are undamaged and new at time of installation.

C. Provide Products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.

D. Substitutions may be considered when the Contractor:

1. Becomes aware of a product or procedure that is more environmentally sensitive or is otherwise advantageous to the Postal Service;
2. Represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;
3. Will provide the same guarantee for the substitution that he would for that specified; and
4. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects, at no additional cost to the Postal Service and at no extension of the Contract completion date.

1.2 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle Products in accordance with manufacturer's instructions, using means and methods that will prevent damage, deterioration and loss, including theft.

B. Schedule Product delivery to minimize long-term storage at Project site and prevent overcrowding of construction spaces.

C. Coordinate Product delivery with installation schedule to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

D. Deliver Products to Project site in undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

E. Promptly inspect shipments to ensure that Products comply with project requirements, quantities are correct, Products are undamaged, and properly protected.

F. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.3 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect Products in accordance with manufacturers' published instructions, with seals and labels intact and legible.

B. Store Products subject to damage by elements above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's published instructions.

C. For exterior storage of fabricated Products, place on sloped supports, above ground.

D. Provide off-site storage and protection when Project site does not permit on-site storage or protection.

E. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of Products.

F. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

G. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

H. Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 017300

EXECUTION

PART 1 – GENERAL

1.1 LAYOUT OF WORK

A. The Contractor must lay out its work from Postal Service-established base lines and benchmarks indicated on the drawings and is responsible for all measurements based on them. The Contractor must furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor as may be required in laying out any part of the work from the base lines and benchmarks established by the Postal Service. The Contractor is responsible for the execution of the work to those lines and grades established or indicated by the COR.

1.2 CONTRACTOR'S TEMPORARY USE OF FACILITIES AND EQUIPMENT

A. No new facilities or equipment intended for the permanent installation, including materials-handling vehicles, may be used for temporary purposes unless specified in the Contract or unless the Contractor has the written permission of the COR.

1.3 FOR CONTRACT WORK PERFORMED IN AN EXISTING OCCUPIED POSTAL FACILITY

A. The Postal Service will continue to operate the facility during performance of the work. Accordingly, the Contractor must arrange and schedule contract work to facilitate such continued use of the site and building, with minimal disruption to Postal operations. Contract work that cannot be performed during normal Postal operating hours and must be performed after hours or during periods when the facility is normally closed, must be coordinated with the COR.

B. If contract work is being performed on the roof, or above or near electronic equipment or mail processing equipment, Contractor must provide temporary interior protection above and/or around such equipment as appropriate or as indicated in construction documents. Interior protection shall be anti-static 6-mil poly. Remove temporary protection upon completion of the work. Coordinate interior protection with local management.

1.4 CLEANING

A. Refer to the terms and conditions of the contract provisions and clauses, including those clauses *Debris and Clean Up*.

B. Cleaning During Construction:
   1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
   2. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
   3. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
   4. Collect and remove waste materials, debris, and rubbish from site as specified in the Environmental Compliance and Management Plan as required in Section 013543 - Environmental Procedures.

C. Final Cleaning:

1. Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.
2. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's published instructions.
3. Complete following cleaning operations before requesting COR inspection for Substantial Completion.
    a. Clean Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste materials, litter and foreign substances. Sweep paved areas broom clean. Remove petro-chemical spills, stains and other foreign deposits. Rake grounds that are neither planted nor paved, to a smooth even-textured surface.
    b. Remove tools, construction equipment, machinery and surplus material from Project Site.
    c. Remove snow and ice to provide safe access to building.
    d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.
    f. Broom clean concrete floors in unoccupied spaces.
    g. Provide final cleaning, waxing, and buffing of resilient tile, in accordance with manufacturer's requirements.
    h. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo if required.
    i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    j. Remove labels that are not permanent labels.
    k. Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces that can not be satisfactorily repaired or restored, or that show evidence of repair or restoration. Do not paint over "UL" and similar labels, including mechanical and electrical name plates.
    l. Wipe surfaces of mechanical and electrical equipment, and other similar equipment. Remove excess lubrication, paint and mortar droppings and other foreign substances.
    m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    n. Replace air disposable filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills. Clean ducts, blowers, and coils if units were operated without filters during construction.
    o. Clean light fixtures, lamps, globes and reflectors to function with full efficiency. Replace burned out bulbs, and defective and noisy starters in fluorescent and mercury vapor fixtures.
    p. Leave Project clean and ready for occupancy.
4. Engage an experienced licensed exterminator to make a final inspection, and rid Project of rodents, insects, and other pests. Comply with regulations of local authorities having jurisdiction.
5. Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction.
6. Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from Project Site and dispose of in accordance with requirements of local authorities having jurisdiction.
7. Where extra materials of value remain after completion of construction, they become Postal Service property and these materials should be stored as directed by COR.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

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SECTION 017419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Procedures for achieving the most environmentally conscious Work feasible within the limits of the Construction Schedule, Contract Sum, and available materials, equipment, and products.
   1. Participate in promoting efforts of Postal Service to create an energy-efficient and environmentally-sensitive structure.
   2. Use recycled-content, toxic-free, and environmentally-sensitive materials and equipment.
   3. Use environmentally-sensitive procedures.
      a. Protect the environment, both on-site and off-site, during demolition and construction operations.
      b. Prevent environmental pollution and damage.
      c. Effect optimum control of solid wastes.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections:
   1. Section 013200 - Construction Progress Documentation.
   2. Section 014000 - Quality Requirements: Contractor's Daily Report.
   3. Section 015000 - Temporary Facilities And Controls: Temporary ventilation, progress cleaning and waste removal.
   4. Section 016000 - Product Requirements: Substitutions.
   5. Section 017704 – Closeout Procedures and Training: Record submittals.
   6. Section 024113 – Selective Site Demolition.

1.2 DEFINITIONS

A. Adequate ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of dust fumes, vapors, or gases.

B. Construction and demolition waste: Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair, and demolition operations.
   1. Rubbish: Includes both combustible and noncombustible wastes but excludes recyclable materials such as paper, boxes, glass, metal, lumber scrap and metal cans.
   2. Debris: Includes both combustible and noncombustible wastes, such as leaves and tree trimmings, stumps and rubble that result from construction or maintenance and repair work.

C. Chemical waste: Includes petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.

D. Diversion: Redirection of waste ordinarily deposited in a municipal landfill to a recycling facility or to another destination for reuse.

E. Environmental pollution and damage: The presence of chemical, physical, or biological elements or agents, which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.

F. Hazardous materials: Includes pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

G. Interior final finishes: Materials and products that will be exposed at interior, occupied spaces; including flooring, wallcovering, finish carpentry, and ceilings.

H. Municipal Solid Waste Landfill: A permitted facility that accepts solid, non-hazardous waste such as household, commercial, and industrial waste, including construction and demolition waste.

I. Packaged dry products: Materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.

J. Sediment: Soil and other debris that has been eroded and transported by storm or well production runoff water.

K. Sanitary wastes:
   1. Garbage: Refuse and scraps resulting from preparation, cooking, distribution, or consumption of food.
   2. Sewage: Domestic sanitary sewage.

L. Wet products: Materials and products installed in wet form, including paints, sealants, adhesives, and special coatings.

1.3 SUBMITTALS

A. Solid Waste Management and Environmental Protection Plan: Prepare and ***submit at the Preconstruction Meeting*** a Solid Waste Management and Environmental Protection Plan including, but not limited to, the following:
   1. Procedures for Recycling/Re-Use Program.
   2. Schedule for application of interior finishes.
   3. Revise and resubmit Solid Waste Management and Environmental Protection Plan as required by Postal Service.
      a. Approval of the Contractor's Solid Waste Management and Environmental Protection Plan, will not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
   4. Any permits required by local, state or federal agencies.

B. With each Contractor's Report as specified in Section 014000 – Quality Requirements, submit an updated Summary Of Solid Waste Disposal And Diversion. Submit on form in Appendix A of this Section. Include manifests, weight tickets, receipts, and invoices specifically identifying the Project and waste material for:
   1. Municipal Solid Waste Landfills.
   2. Recycling/Reuse Facilities.

C. With Record Submittals as specified in Section 017704 - Closeout Procedures and Training, submit the following:
   1. Final Summary Of Solid Waste Disposal And Diversion. Submit on form in Appendix A of this Section.
   2. Resource Conservation and Recovery Act Project Summary. Submit on form in Appendix B of this Section.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.1 RECYCLING AND REUSE

A. Collection: Implement a recycling/reuse program that includes separate collection of waste materials of the following types as appropriate to authorized local and regional recycling/reuse facilities:
   1. Asphalt.
   2. Concrete.
   3. Metal.
      a. Ferrous.
      b. Non-ferrous.
   4. Wood.
   5. Debris.
   6. Glass.
   7. Clay brick.
   8. Paper/Cardboard.
   9. Plastic.
   10. Gypsum.
   11. Paint.
   12. Carpet.
   13. Others as appropriate.

B. Recycling/reuse centers: Contact state and/or local governmental solid waste offices, Environmental Protection Agency (EPA) regional offices, and authorized applicable non-profit organizations.
   1. Asphalt
   2. Concrete.
   3. Metal.
   4. Wood.
   5. Debris.
   6. Glass.
   7. Clay brick.
   8. Paper/Cardboard.
   9. Plastic.
   10. Gypsum.
   11. Paint.
   12. Carpet.
   13. Others as appropriate.

C. Handling:
   1. Clean materials which are contaminated prior to placing in collection containers. Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.
   2. Arrange for collection by or delivery to the appropriate recycling or reuse facility.

D. Participate in re-use programs: identify local and regional re-use programs, including but not limited to non-profit organizations such as schools, local housing agencies, and public arts programs, that accept used materials. The following are examples for Contractor's information only.
   1. National materials exchange network, such as CAL-MAX, a free service provided by various state and regional offices, designed to help businesses find markets for materials that traditionally would be discarded. The premise of the program is that material discarded by one business may be a resource for another business.

a. Items and regions covered by materials exchange programs may vary. Contact the applicable regional materials exchange program. In California, contact CAL-MAX at (916) 255-2369.

2. Habitat For Humanity, a non-profit housing organization that rehabilitates and builds housing for low income families.
   a. Sites requiring donated materials vary. Contact the national hotline (800) HABITAT.

E. Rebates, tax credits, and other savings obtained for recycled or re-used materials accrue to Contractor.

3.2 ENVIRONMENTAL CONTROLS

A. Protection of natural resources: Preserve the natural resources within the Project boundaries and outside the limits of permanent Work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by Postal Service, upon completion of the Work.
   1. Confine demolition and construction activities to work area limits indicated on the Drawings and as directed by COR.
      a. Temporary construction: As specified in Section 015000 - Temporary Facilities And Controls.
      b. Demolition and salvage operations: As specified in Section 024119 - Selective Structure Demolition.
      c. Disposal operations for demolished and waste materials that are not identified to be salvaged, recycled or reused:
         1) Remove debris, rubbish, and other waste materials resulting from demolition and construction operations, from site.
         2) No burning permitted.
         3) Transport materials with appropriate vehicles and dispose off-site to areas which are approved for disposal by governing authorities having jurisdiction.
         4) Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways. Remove spillage and sweep, wash, or otherwise clean project site, streets, or highways.
         5) Comply with applicable federal, state and/or local regulations.
   2. Water resources as follows:
      a. Comply with requirements of the National Pollutant Discharge Elimination System (NPDES) and the State Pollutant Discharge Elimination System (SPDES).
      b. Oily substances: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water.
         1) Store and service construction equipment at areas designated for collection of oil wastes.
      c. Mosquito abatement: Prevent ponding of stagnant water conducive to mosquito breeding habitat.
      d. Prevent run-off from site during demolition and construction operations.
   3. Land resources: Prior to construction, identify land resources to be preserved within the Work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from Postal Service.
   4. Air Resources: Prevent creation of dust, air pollution, and odors.
      a. Use water sprinkling, temporary enclosures, and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level.
         1) Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.
      b. Do not use any hazardous chemicals on USPS property when it is a shared work space with USPS employees. If chemicals are authorized for use, store volatile liquids, including fuels and solvents, in closed containers.

c. Properly maintain equipment to reduce gaseous pollutant emissions.
d. Interior final finishes: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible in accordance with Postal Service approved Solid Waste Management and Environmental Protection Plan.
e. Temporary Ventilation: As specified in Section 015000 - Temporary Facilities And Controls, and as follows:
    1) Provide adequate ventilation during and after installation of interior wet products and interior final finishes.
    2) Provide adequate ventilation of packaged dry products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Provide a temperature range of 60 degrees F minimum to 90 degree F maximum continuously during the ventilation period. Do not ventilate within limits of Work unless otherwise approved by the COR.
f. Pre-occupancy ventilation: After final completion and prior to initial occupancy, provide adequate ventilation for minimum 5 days. Pre-occupancy ventilation procedures:
    1) Use supply air fans and ducts only.
    2) Temporarily seal exhaust ducts.
    3) Temporarily disable exhaust fans.
    4) Provide exhaust through operable windows or temporary openings.
    5) Provide temporary exhaust fans as required to pull exhaust air from deep interior locations. Stair towers may be used for exhausting air from the building during the temporary ventilation.
    6) After pre-occupancy ventilation and prior to final testing and balancing of HVAC system, replace air filters and make HVAC system fully operational.

5. Fish and Wildlife Resources: Manage and control construction activities to minimize interference with, disturbance of, and damage to fish and wildlife.
6. Noise Control: Perform demolition and construction operations to minimize noise. Perform noise producing work in less sensitive hours of the day or week as directed by Postal Service .
    a. Repetitive, high level impact noise will be permitted only between the hours of 8:00 a.m. and 6:00 p.m. Do not exceed the following dB limitations:

Sound Level in dB	Time Duration of Impact Noise
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour

    b. Provide equipment, sound-deadening devices, and take noise abatement measures that are necessary for compliance.

END OF SECTION

Appendix A

SUMMARY OF SOLID WASTE DISPOSAL AND DIVERSION

Project Name: ___ FMS Project Number: ___

Contractor Name: _____ License Number: _____

Contractor Address: _____

Solid Waste Material	**Date Material** Disposed/ **Diverted**	**Amount Disposed/ Diverted** (ton or cu. yd)	**Municipal Solid Waste Facility** (name, address, & **phone number)**	**Recycling/Reuse Facility (name, address, & phone number)**	**Comments (if disposed, state why not diverted)**
Asphalt					
Concrete					
Metal					
Wood					
Debris					
Glass					
Clay brick					
Paper/ Cardboard					
Plastic					
Gypsum					
Paint					
Carpet					
Other:					

Signature: _____ Date: _____

RESOURCE CONSERVATION AND RECOVERY ACT - PROJECT SUMMARY.

Project Name: ___ FMS Project Number: ___

Contractor Name: _____ License Number: _____

Contractor Address: _____

1.0 EPA GUIDELINE ITEMS

A. Fly Ash:

1. Total dollar amount of concrete and cement provided for this project. $_____.
2. Total dollar amount of concrete and cement containing fly ash provided for this project. $_____.
3. Were there any technical impediments to increasing the amount of concrete and cement containing fly ash provided for this project? _____.
   a. If yes, please explain. _____
   _____
   _____
   _____.

B. Building Insulation Products:

1. Total dollar amount of building insulation products provided for this project. $_____.
2. Total dollar amount of building insulation products containing recycled materials provided for this project. $_____.
3. Were there any technical impediments to increasing the amount of building insulation products containing recycled materials provided for this project? _____.
   a. If yes, please explain. _____
   _____
   _____
   _____.

C. Carpet:

1. Total dollar amount of carpet provided for this project. $_____.
2. Total dollar amount of carpet containing recycled materials provided for this project. $_____.
3. Were there any technical impediments to increasing the amount of carpet containing recycled materials provided for this project?_____.
   a. If yes, please explain. _____
   _____
   _____
   _____.

D. Floor Tiles (resilient):

1. Total dollar amount of floor tile (resilient) provided for this project. $_____.
2. Total dollar amount of floor tile (resilient) containing recycled materials provided for this project. $_____.
3. Were there any technical impediments to increasing the amount of floor tile (resilient) containing recycled materials provided for this project? _____.
   a. If yes, please explain. _____
   _____
   _____
   _____.

E. Floor Tiles (ceramic):

1. Total dollar amount of floor tile (ceramic) provided for this project. $_____.
2. Total dollar amount of floor tile (ceramic) containing recycled materials provided for this project. $_____.
3. Were there any technical impediments to increasing the amount of floor tile (ceramic) containing recycled materials provided for this project? _____.
   a. If yes, please explain. _____
   _____
   _____
   _____.

F. Hydraulic Mulch:

1. Total dollar amount of hydraulic mulch provided for this project. $_____.
2. Total dollar amount of hydraulic mulch containing recycled materials provided for this project. $_____.
3. Were there any technical impediments to increasing the amount of hydraulic mulch containing recycled materials provided for this project? _____.
   a. If yes, please explain. _____
   _____
   _____
   _____.

G. Compost:

1. Total dollar amount of compost provided for this project. $_____.
2. Total dollar amount of compost containing recycled materials provided for this project. $_____.
3. Were there any technical impediments to increasing the amount of hydraulic mulch containing recycled materials provided for this project? _____.
   a. If yes, please explain. _____
   _____
   _____
   _____.

2.0 SPECIFICATIONS

NOT USED

3.0 SOLID WASTE PREVENTION

A. Total dollar amount of solid waste disposed (landfill) for this project. $_____.

B. Total weight of solid waste disposed (landfill) for this project. $_____.

4.0 RECYCLING

A. Total dollar value of solid waste diverted from landfill and recycled or reused for this project. (Express as total dollar amount for solid waste disposal in landfill for equivalent type and amount of diverted waste.)
$_____.

B. Total weight of solid waste diverted from landfill and recycled or reused for this project. (Express as total weight for solid waste disposal in landfill for equivalent type and amount of diverted waste.)
Tons_____.

5.0 COMMENTS

A. Comments and suggestions for increasing amount of recycled materials used in construction materials.
_____
_____
_____
_____
_____
_____.

B. Comments and suggestions for improving solid waste prevention and recycling efforts during construction.
_____
_____
_____
_____
_____
_____.

Signature: _____ Date: _____

SECTION 017704

CLOSEOUT PROCEDURES AND TRAINING

PART 1 – GENERAL

1.1 MANUALS

A. Purpose: Operation and maintenance manuals are for the training of, and use by, Postal Service employees in the operation and maintenance of the systems and related equipment as specified below. The manuals must consist of instruction on systems and equipment. A separate manual or chapter must be prepared for each of the following classes of equipment or system:
1. Roof system.
2. Mechanical systems.
3. Electrical systems.

B. Content: Unless otherwise indicated, each chapter must contain the following, as applicable:
Introduction.
Table of contents.
Description of system (including design intent and considerations).

C. Preparation: The outline below is intended as a general guide for preparing the manuals. The manuals must be prepared to provide for the optimum operation and maintenance of the various systems. The description of systems and general operating instructions for plumbing and electrical manuals may cover only complicated or unusual parts of these systems, such as sewage ejectors, transformers, high tension switchgear, and signal and alarm systems. Manufacturer's literature and data must be those of the actual equipment installed under contract for the particular facility. Further guidance is available in the ASHRAE Handbook, 1984, Systems Volume, Chapter 39, Mechanical Maintenance.

D. Suggested Outline for Operation and Maintenance (O&M) Manuals: This is a suggested outline, with general requirements of O&M manuals. The outline is presented to indicate the extent of material to be covered and the individual items required in manuals for Mail Processing Facilities. The outline may be modified to suit specific installations; however, the purpose of the manual must be fulfilled. The manual is not intended to duplicate manufacturers' data, but proper references must be made in the text of the O&M manual to indicate that that information is applicable and where it is located.
1. Part I. Description and Design Intent
    a. Introduction
        1) Provide a brief description of project and purpose of the maintenance manual. The following statements must be included: "Operation and maintenance of this equipment must be performed in accordance with this manual and posted instructions, subject to compliance with applicable technical guides and standards issued by USPS. It is recognized that minor changes in control points and settings will be required, based on actual operating experience, to correct varying conditions and improve operation. When such changes appear necessary, they must be submitted to the maintenance manager for consideration. Upon approval of any changes, the applicable portions of all copies of the manual and proposed instructions must be revised and reissued, and any change in operating procedure brought to the attention of all operating personnel."
        2) "This manual is specifically developed to assist the Postal official in charge at the facility to operate and maintain the building systems and equipment. Manufacturers' recommendations set forth for certain components must be followed during the complete warranty period for that equipment."

3) Contents of Manual. This portion of the introduction must explain that the manual is to contain complete operating, maintenance, and safety instructions for all equipment listed. It must also contain any other appropriate references as required to outline an explanation of the manuals and major categories of reference material required with the manuals.

b. Table of Contents

1) The table of contents must list numbers and titles of chapters, sections, and main paragraphs, with their page numbers. Each volume in a set of manuals must contain its own table of contents. Publications containing 10 or more illustrations or tables must include a list of illustrations or tables, as applicable. These lists must show number, title, and page number of each illustration and table. Following is a typical table of contents:

a. Roof System

1.) Roof and flashing type
2.) Local inspection (frequency and what is included)
3.) Maintenance (when manufacturer performs, if USPS performs what methods compatible materials, etc.)

b. Mechanical Systems

1.) Space conditioning
2.) Heating
3.) Central chilled water and distribution
4.) HVAC instrumentation and controls

c. Electrical Systems

1.) Incoming Service
2.) Electrical power distribution
4.) Fire alarm

2. Part II. Operating Sequence and Procedures

a. Contents: Each chapter must describe the procedures necessary for Postal Service personnel to operate the system and equipment covered in that chapter.

b. Operating Procedures: The operating procedures must be divided into four subsections: Startup, Operation, Emergency Operation, and Shutdown.

1) Startup: Give complete instructions for energizing the equipment and making initial settings and adjustments whenever applicable. If equipment is fully automatic, a statement to that effect is all that is required. If a specific sequence of steps must be performed, give step-by-step instructions in the proper sequence. If timing- (such as warm-up between power-on and adjustment) is important, clearly state the specific minimum time required at the proper point in the procedure. Refer to controls and indicators by panel; make references consistent with the nomenclature used in illustrations and tables of controls and indicators. If preliminary settings differ for different modes of operations, give procedures for each mode.

2) Operation: Give detailed instructions in proper sequence for each mode of operation. When, for a given action on the part of the operator, alternate equipment responses are possible, give the appropriate operation reaction to each.

3) Emergency Operation: If some functions of the equipment can be operated while other functions are disabled, give instructions for operations under these conditions. Include here only those alternate methods of operation (from normal) that the operator can follow when there is a partial failure or malfunctioning of components, or other unusual condition.

4) Shutdown: Include instructions for stopping and securing the equipment after operation. If a particular sequence is required, give step-by-step instructions in that order.

3. Part III. Maintenance Instructions and Requirements

a. Contents: Each chapter must describe the procedures necessary for Postal Service personnel to perform the maintenance on the systems and equipment covered in that chapter. Emphasis must be placed on the method of mechanical control of systems and equipment from a maintenance standpoint. References must be made, as appropriate, to drawings, schematics, and sequences of operation included as part of the construction Contract drawings and specifications that show piping and equipment arrangements and items of control. Prints of these drawings must be reduced to 11 inches x 17 inches for insertion in the manuals. Drawings must represent the "as-built" condition.

b. Maintenance Procedures: The maintenance procedures must be divided into two categories: Preventive Maintenance and Corrective Maintenance.

1. Preventive Maintenance

a. Provide a schedule for preventive maintenance. State, preferably in tabular form, the recommended frequency of performance for each preventive maintenance task (cleaning, inspection, and scheduled overhauls).

b. Provide instruction and schedules for all routine maintenance cleaning and inspection, with recommended lubricants.

c. If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria for, but not limited to, the following:

1.) Motors
2.) Controls
3.) Filters
4.) Heat exchangers

2. Provide instruction for minor repairs or adjustments required for preventive maintenance routines. Minor repair and adjustment must be limited to repairs and adjustments that may be performed without special tools or test equipment and that require no special training or skills. Identify test points and give values for each.

c. Corrective Maintenance

1. Corrective Maintenance: Corrective maintenance instructions must be predicated upon a logical effect-to-cause troubleshooting philosophy and a rapid replacement procedure to minimize equipment downtime. Instructions and data must appear in the normal sequence of corrective maintenance, for example, troubleshooting first, repair and replacement of parts second, and then the parts list.

2. Troubleshooting: This information must describe the general procedure for locating malfunctions and must give, in detail, any specific remedial procedures or techniques. The data shown are intended to isolate only the most common equipment deficiencies. Troubleshooting tables, charts, or diagrams may be used to present specific procedures. A guide to this type must be a three-column chart. The columns must be entitled Malfunction, Probable Cause, and Recommended Action. The information must be alphabetically arranged by component, and each component must, in turn, list deficiencies that may be expected. Each deficiency must contain one or more problems with a recommended correction.

3. Repair and Replacement: Indicate the repair and replacement procedures most likely to be required in the maintenance of the equipment. Information included here must consist of step-by-step instructions for repair and replacement of defective items. Include all information required to accomplish repair or replacement, including

information such as torque values. Identify all tools, special equipment, and materials that may be required. Identify uses for maintenance equipment. The paragraphs must contain headings to identify the topics covered.

4. Safety Precautions: This subsection must comprise a listing of safety precautions and instructions to be followed before, during, and after repairs or adjustments are made or routine maintenance is performed.

d. Manufacturers' Brochures: Include manufacturers' descriptive literature covering devices used in the system, together with illustrations, exploded views, and renewal parts lists. This section must also include special devices manufactured by the Contractor.

e. Special Maintenance: Provide information of a maintenance nature covering warranty items that have not been discussed elsewhere.

f. Shop Drawings: Provide a copy of all approved shop drawings covering approval of equipment for the project with the manufacturers' brochures.

g. Spare Parts Lists: Include a recommended spare parts list for all equipment furnished for the project. The parts list must include a tabulation of descriptive data for all the electrical-electronic spare parts and all the mechanical spare parts proposed for each type of equipment or system. Each part must be properly identified by part number and manufacturer.

h. Warranty: Include a copy of the “special” or extended warranty in the operation and maintenance manual.

E. Submittal, In both “hard” and electronic DVD or CD-ROM format:

1. Preliminary Submittal: Two draft copies of the completed manuscript for items in this outline must be submitted to the COR for review within 30 days after approval of equipment to be provided. One copy will be returned to the Contractor within 15 days after submittal and, if required, must be revised and resubmitted within 15days.
2. Final Submittal: four complete sets of manuals must be furnished to the COR not later than 15 days before completion of the project.
3. Final Submittal must be accepted by the COR before training can begin.

1.2 POSTED OPERATING INSTRUCTIONS

A. General. Operating instructions and diagrams must be prepared for posting near the equipment. Posted operating instructions must be photographic or equal non-fading reproductions framed under glass or encased in non-discoloring plastic and must be mounted in locations as directed. Copies of the posted operating instructions must also be used with the O&M manuals as a basis for training Postal Service personnel in the operation and maintenance of systems and related equipment installed under contract at the facility.

B. Posted operating instructions must consist of simplified, consolidated equipment, control, and power diagrams graphically representing the entire system and actual equipment installed, including concise written instructions on how to start and stop systems, what settings and conditions are to be observed, and what control adjustments are to be made or maintained by the operation. Posted operating instructions must include, but are not limited to the following:

1. Boiler and burner controls.
2. Refrigeration controls.
3. Heating, ventilating, and air-conditioning controls for each system.
4. Controls for dust collection systems.
5. One-line schematic diagrams of water supply (plumbing).
6. One-line diagrams of steam distribution and hot water and chilled water systems, including risers, main shutoff valves, balancing cocks, and the like.
7. One-line isometric diagrams of sanitary drainage.

1.3 TRAINING

A. The Contractor must train Postal Service personnel in the operation and maintenance of mechanical and electrical equipment. Coordination must be maintained with systems designers for developing the hours of instruction and scope of material to be covered. Training of Postal Service personnel must not begin until the COR has approved the final submittal copy of each O&M manual.

B. Schedule Submittal: The proposed scope of training and materials and instruction schedule must be submitted for review and approval approximately 30 days before the scheduled completion of the buildings. Mutually agreeable dates for training must be arranged with the COR, but the training must be completed before final acceptance of the facility.

C. Scope of Training: Training must include classroom and on-the-job instructions by qualified installation and maintenance personnel having the necessary knowledge, experience, and teaching skills. The use of recording on digital media (DVD or CD discs) during the instruction period is required. Discs must be turned over to the COR after training has been completed.

D. Time Period of Training: The minimum specific hours of training time required for each category of major equipment and systems is indicated below. Past experience indicates a workable ratio in the vicinity of approximately 25 percent classroom to 75 percent application, except that the ratio may be reversed for control systems. The COR must have the option of redistributing the training times, subject to the total time specified. Training must be presented on an 8-hour per day, 5-day per week schedule, with all reading assignments and review to be within this period.

1.4 TRAINING PERIOD

Item	Time (Hours)
1. Heating Plant Covers heat-generating equipment, such as heat exchangers, boilers, and burners; electric resistance heating; and related equipment, where applicable (including combustion testing), together with associated operation and safety controls.	8
2. Ventilation Covers air-handling units with heating and cooling coils, fans, and all other air-handling equipment, together with associated operating and limit controls.	8
3. Overall Control System Covers central control center, coordinating respective controls of heating, cooling, and ventilation systems, and shows how these controls work together to provide an integrated overall control of the complete air-conditioning system, both heating and cooling, as well as all other utility control systems.	8

1.5 TRAINING PARTICIPATION SHEETS

A. Submit to the COR sign-in sheets with the dates and names of all training participants. Training sheets must be reviewed and certified by an authorized facility manager.

1.6 OTHER CLOSEOUT SUBMITTALS

A. Additional requirements for Systems Manuals, Operating Instructions, Training and other deliverables are contained in individual Specification Sections. All closeout requirements must be provided to and accepted by the COR prior to requesting final payment. Examples of additional closeout requirements include, but are not limited to, the following
   1. Final Punch-List with all items certified as complete.
   2. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Record "As Built" Drawings*, the Contractor shall submit

certified As-Built Record Drawings and Specifications in the quantities and media specified.

3. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Warranty*, the Contractor shall submit all transferable guarantees and warranties for equipment, materials and installations furnished by any manufacturer, supplier, or installer.
4. Signed Asbestos and Lead-Based Paint Certificate.
5. RE-4 Certification of Accessibility (CoA) and Facility Accessibility Survey Report.
6. Material Safety Data Sheets.
7. Signed and sealed Contractor Release of Claims.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 019113

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Commissioning requirements common to all Sections.

B. Systems and equipment start-up and functional performance testing.

C. Validation of proper and thorough installation of systems and equipment.

D. Equipment performance verification.

E. Documentation of tests, procedures, and installations.

F. Training.

1.2 SCOPE

A. The Commissioning (“Cx”) Plan outlines the commissioning process outside of the Construction Contract. The specification sections dictate all requirements of the commissioning process relative to the Construction Contract. The Cx Plan is available for reference at the request of the Contractor; however it is not part of the Construction Contract.

B. This Section and other Sections of the specification detail the Contractor’s responsibilities relative to the Cx process and it expands on the Cx Plan, which covers the roles and responsibilities of Parties outside of the Construction Contract. The degree of commissioning that will be required for this project shall include the specific requirements listed in the Division 22, 23 and/or 26 specifications.

1.3 GENERAL DESCRIPTION

A. Commissioning (“Cx”) is the process of ensuring that all building systems are installed and perform interactively according to the design intent; that systems are efficient and cost effective and meet the Postal Service’s operational needs; that the installation is adequately documented; and that the Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building systems from installation to full dynamic operation and optimization.

B. The Postal Service shall either retain a qualified independent Commissioning Authority (CxA), directly, to provide Commissioning Services, or will require the project A/E to do so.

C. CxA shall work with the Contractor, the AE, and the Postal Service Project Manager to direct and oversee the Cx process and perform functional performance testing.

D. The Cx process shall begin at the 95% review of the design documentation for Design/Build (DB), R&A and Design/Bid/Build (DBB) projects. However, the work shall commence at the 30% design stage for special projects, such as Geothermal, Compressed Natural Gas or Electrical Generation Projects.

1.4 RELATED WORK AND DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section

B. Commissioning Plan: The Cx Plan shall be available for reference as it outlines responsibilities outside of the Construction Contract. It gives the Contractor a perspective as to the overall process. It encompasses the entire Cx process including design phase and post construction tasks.

C. Section 013300 - Submittal Procedures: Stipulates additional copies of submittals to be submitted and refers to other sections for additional submittal requirements related to Cx.

D. Section 017704 - Closeout Procedures and Training: Defines the milestones in completion incorporating the Cx process.

E. Individual Specification Sections: Individual sections stipulate installation, start-up, warranty, O&M documentation, and training requirements for the system or device specified in the Section.

1.5 REFERENCE STANDARDS

A. ASHRAE Guideline, "Guideline for Commissioning HVAC Systems"

B. ASHRAE Guideline, “Preparation of Operating and Maintenance Documentation for Building Systems”

C. AABC Commissioning Group (ACG)

D. NEBB – Procedural Standards for Building Systems Commissioning

E. National Electric Code (NEC)

F. American Society for Testing and Materials (ASTM)

G. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)

H. Illuminating Engineering Society (IES)

I. Institute of Electrical and Electronics Engineers (IEEE)

J. International Electrical Testing Association (NETA)

K. National Electrical Manufacturers Associates (NEMA)

L. National Fire Protection Association (NFPA)

M. Underwriters Laboratory, Inc. (UL)

1.6 DOCUMENTATION

A. Contractor shall provide to the CxA the following per the procedures specified herein and in other Sections of the specification:
   1. Drawings and Data. One hard copy and one electronic copy of Drawings and product data related to systems or equipment to be commissioned. CxA shall review and incorporate comments for Contractor’s consideration.
   2. Draft Start-Up Procedures. Contractor shall develop Start-up Procedures for all applicable equipment and systems along with the manufacturer’s application, installation and start-up procedures. CxA will initially provide to the Contractor generic Start-up Checklists, the content of which must be reviewed by the Contractor and supplemented

with manufacturer-specific requirements and the Contractor's own internal quality assurance procedures and checks. CxA will review draft and recommend approval or provide comments.

3. Schedule Updates. Issue periodic updates to the construction schedule.
4. Action Item Response. Respond to Action Items by Cx team members.
5. Field Testing Agency Reports (other than TAB). Provide all documentation of work of independent testing agencies required by the specification. These shall be provided prior to Acceptance Phase. Field Testing Agency Reports should be provided in PDF electronic format.
6. Completed Start-Up Procedures. Completed Start-Up Procedure documentation for all applicable equipment and systems.
7. Equipment Warrantees. Provide prior to the start of the Acceptance Phase.

B. Record Drawings: Contractor shall maintain at the site an updated set of record or 'As-Built' documents reflecting actual installed conditions and all approved changes and modifications to the contract documents. Contractor shall provide access to the CxA to review the As-Built and Record Drawings. Provide Record Drawings in accordance with Division 1.

C. Reports. The Cx agent shall provide a final report with executive summary of overall results, description of items commissioned, test data, conclusions, recommendations, etc. to the COR within 14 days after the completion of the commissioning process. If, due to circumstances beyond the control of the Cx agent, the Cx process cannot be completed in accordance with the schedule, then, at the discretion of the COR, a preliminary report shall be submitted detailing the results of the Cx activities completed thus far, with a final report to be submitted at a later agreed upon date.

1.7 COMMISSIONING SCHEDULING

A. The Cx will be categorized into Phases as indicated below. Note that per schedule, different systems and/or areas may be in different phases at any given time given that the Cx and testing process will be integrated into the construction process:

1. Construction Phase: This is the period of time where the systems are installed, much of the Cx documentation is developed, the systems are started, and the majority of the Contractor required training is performed. On any given system or area, the Construction Phase will end when the CxA approves proceeding with the Functional Performance testing.
2. Acceptance Phase: This is the period of time where the systems will be functionally tested and the systems will operate through an endurance period.
3. Warranty Phase: This is the period of time that coincides with the start and end of the Contractor's base warranty.

1.8 CONTRACTOR RESPONSIBILITIES

A. Construction Phase: The Postal Service shall provide independent Cx Services directly, or through the project A/E. The A/E shall be responsible for coordinating with the CxA as necessary to assist them in completing the Cx Report. In particular, the Contractor shall be responsible for providing assistance from their test and balance contractor, BAS controls contractor, mechanical contractor, electrical contractor, etc. to confirm that the functionality of the new equipment meets the original design intent, operates efficiently, and demonstrates that all of the required features of the new system are functioning as specified in the design documents.

B. Acceptance Phase: The following delineates the Cx-related responsibilities of the Contractor (and their subcontractors) during the Acceptance Phase.

1. Assist CxA in functional performance testing. Assistance will generally include the following:
   a. Manipulate systems and equipment to facilitate testing.

b. Provide any specialized instrumentation necessary for functional performance testing.
c. Manipulate systems to facilitate functional performance testing.

2. Correct any work not in accordance with Contract Documents.
3. Maintain record documentation, and update and resubmit it after completion.

C. Warranty Phase: The following delineates the Cx-related responsibilities of the Contractor (and their subcontractors) during the Warranty Phase.
1. Provide warranty service;
2. Participate as required in opposite season testing;
3. Correct any deficiencies identified throughout the Warranty Phase;
4. Update record documentation to reflect any changes made throughout the Warranty Phase.

1.9 CX KICK OFF/COORDINATION MEETING

A. CxA shall schedule and conduct a Cx coordination meeting at the appropriate time after the award of the Construction Contract.

1.10 START-UP PROCEDURES AND DOCUMENTATION

A. Purpose: The Cx process requires that the normal quality control processes involved with preparing systems and equipment for operation are performed to a high standard of care and are thoroughly documented. The Start-up procedures shall be performed to all systems and equipment specified in the Contract documents. The Cx process requires all Parties to collaborate to establish the optimal standard of care for starting systems and equipment. The Contractor performs the Start-up procedures, documents the results, and provides them to the CxA.

B. Sampling and Final Submission: All systems shall be started and documented per the approved procedures and NO sampling strategy is used. Completed Start-up and pre-functional checklists for all pieces of equipment shall be submitted to CxA prior to any associated functional performance testing.

C. Postal Service Access: Contractor shall allow access by Postal Service representatives to inspect the equipment and ensure its proper operation.

1.11 FUNCTIONAL PERFORMANCE TESTING

A. The objective of Functional Performance Testing is to demonstrate that each system is operating according to the documented design intent of the Contract Documents. Functional Performance Testing facilitates bringing the systems from a state of functional completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

B. The logistics and procedures involved in Functional Performance Testing are outlined below.

1.12 TRAINING

A. Adequate and thorough training of the Operators and the facilities staff is vital to effective transition and early occupancy of the building. A key goal of the Cx Team is to ensure that this is accomplished. Contractors, Subcontractors, and Manufacturers/Vendors as specified shall prepare and conduct training sessions on the installed systems and equipment for which they are responsible. The Contractor shall be responsible for insuring all other training is performed in accordance with the Contract Documents.

PART 2 – PRODUCTS

2.1 INSTRUMENTATION

A. All testing equipment used in the Cx process shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available.

B. Testing Instrumentation: Contractor shall provide all instrumentation necessary for tests for which they are responsible. CxA will provide standard instrumentation for measuring medium and low voltage electrical voltage, current, power factor, power, and THD. CxA will provide receptacle testers for normal and GFI receptacle tests. Contractor shall provide all other instrumentation required to accomplish the specified testing.

C. Test kits for meters and gages shall be provided to the Postal Service new. Previously used test kits will be unacceptable. Kits shall be submitted prior to the Acceptance Phase.

PART 3 – EXECUTION

3.1 START-UP STANDARD OF CARE

A. Procedures that establish a minimum Standard-of-Care for the start-up, check out and testing of applicable equipment are specified in the individual technical specifications. Contractor shall apply this Standard-of-Care and document per the Cx requirements.

3.2 START-UP/FUNCTIONAL TEST PROCEDURES - GENERAL

A. This Section outlines 'generic' or minimally acceptable Start-Up and Functional Test Procedures for systems and equipment. These items shall provide a minimum guideline for the Contractor to determine the level of care required for start-up of the systems.

3.3 PROCEDURES COMMON TO ALL SYSTEMS

The following start-up verifications/procedures are common to all systems.

A. Checkout shall proceed from devices to the components to the systems.

B. Verify labeling is affixed per spec and visible.

C. Verify prerequisite procedures are done.

D. Inspect for damage.

E. Verify system is applied per the manufacturer's recommendations.

F. Verify system has been started up per the manufacturer's recommendations.

G. Verify that access is provided for inspection, operation and repair.

H. Verify that access is provided for replacement of the equipment.

I. Verify the record drawings, submittal data and O&M documentation accurately reflect the installed systems.

J. Verify all gages and test ports are provided as required by Contract Documents and manufacturer's recommendations.

K. Verify all recorded nameplate data is accurate.

L. Verify that the installation is done in a manner that ensures safe operation and maintenance.

M. Verify specified replacement material/spare parts have been provided as required by the Construction Documents.

N. Verify all rotating parts are properly lubricated.

O. Verify all monitoring and ensure all alarms are active and set per Postal Service's requirements.

END OF SECTION

SECTION 024119

SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: The Contract Documents, as defined in Section 011000- Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

B. Related Sections:
1. Section 013543- Environmental Procedures: Recycling and reuse of waste materials.

1.2 SYSTEM DESCRIPTION

A. The extent of Selective Demolition Work is that Work necessary, and required to facilitate the new construction indicated.

B. Demolition shall be such that all construction, new and existing, can be performed, and completed in accordance with the construction documents.

C. The contractor shall visit the project site and familiarize himself with the existing conditions and project requirements.

D. Verify the scope of the Work under this Section including salvage material. The United States Postal Service will be responsible for removing all materials and equipment which the United States Postal Service wishes to salvage prior to the beginning of this Work.

1.3 QUALITY ASSURANCE

A. Engage only personnel who can demonstrate not less than five years successful experience in Work of similar character.

B. Performance Criteria:
1. Requirements of Structural Work: Do not cut structural work in a manner resulting in a reduction of load-carrying capacity of load/deflection ratio.
2. Operational and Safety Limitations: Do not cut operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in a manner intended or resulting in a decreased operational life, increased maintenance or decreased safety.
3. Visual Requirements: Do not cut work which is exposed on the exterior or exposed in occupied spaces of the building in a manner resulting in a reduction of visual qualities or resulting in substantial evidence of the demolition work judged by the Architect to be cut and patched in a visually unsatisfactory manner.
4. Loading: Do not superimpose loads at any point upon existing structure beyond design capacity including loads attributable to materials, construction equipment, demolition operations and shoring and bracing.
5. Vibration: Do not use means, methods, techniques or procedures which would induce vibration into any element of the structure.
6. Fire: Do not use means, methods, techniques or procedures which would produce any fire hazard unless otherwise approved by Contracting Officer.

7. Water: Do not use means, methods, techniques or procedures which would produce excessive water run-off, and water pollution.
8. Air Pollution: Do not use means, methods, techniques or procedures which would produce uncontrolled dust, fumes or other damaging air pollution.

1.4 PROJECT SITE

A. Indicated "Existing Construction" was obtained from existing drawings or other information which may not reflect actual conditions. The Contractor shall verify all existing conditions and notify the Contracting Officer of discrepancies before proceeding with the Work.

B. Perform the removal, cutting, drilling, etc., of existing work with extreme care, and using small tools in order not to jeopardize the structural integrity of the building.

C. Occupancy: Facility will remain fully occupied and operational throughout construction. Contractor shall have controlled access to the facility for construction activities during normal business hours.

D. Condition of Structure: The United States Postal Service assumes no responsibility for the actual condition of portions of the structure to be demolished.

E. Protection: Make sure that the safe passage of persons around the area of demolition is maintained during the demolition operation. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

1.5 PROTECTION OF EXISTING CONSTRUCTION

A. Provide temporary protection of existing construction (floors, roof, and walls) when adjoining new work and in traffic areas.

B. Provide temporary construction, constructed of framing and plywood, to protect existing construction and surrounding surfaces from damage by movement of materials and personnel.

C. The contractor is responsible for all damage to existing structure and shall replace or repair all areas of damage.

D. Repair, replace, or rebuild existing construction as required or as directed which has been removed, altered or disrupted to allow for new construction. Existing construction shall be corrected to match adjacent construction, new or existing.

E. Perform cutting of existing concrete and masonry construction with saws and core drills. Do not use jack-hammers or explosives.

1.6 SHORING AND BRACING

A. Provide temporary shoring of existing construction to allow removal of existing structural elements. Maintain shoring until new structural elements are in place and accepted.

PART 2 - PRODUCTS

2.1 SALVAGED ITEMS FOR RE-USE

A. Materials and items scheduled for re-use which are damaged by the contractor to the extent which they cannot be re-used shall be replaced by the Contractor at no additional cost to the United States Postal Service.

B. Contractor shall remove and salvage the existing roof hatch and access ladder for re-use. Store on site in protected area for reinstallation as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 PREPARATION

A. Temporary Support: Provide adequate temporary support for work to be cut to prevent failure. Do not endanger other work.

B. Provide adequate protection of other work during selective demolition to prevent damage and provide protection of the work from adverse weather exposure.

3.3 PROCEDURE

A. Employ only skilled tradesmen to perform selective demolition.

B. Cut work by methods least likely to damage work to the retained and work adjoining.

C. In general, where physical cutting action is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through concrete and masonry work.

D. Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work.

E. Where selective demolition terminates at a surface or finish to remain, completely remove all traces of material selectively demolished, including mortar beds. Provide smooth, even, substrate transition.

3.4 POLLUTION CONTROLS

A. Use temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level.

B. Comply with governing authorities pertaining to environmental protection.
   1. Protect natural resources as specified in Section 013543 - Environmental Procedures.

C. Clean adjacent portion of the structure and improvement of dust, dirt and debris caused by demolition operations, as directed by Contracting Officer and governing authorities. Return adjacent areas to conditions existing prior to the start of the work.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Collect, recycle, reuse, and dispose of demolished materials as specified in Section 013543 - Environmental Procedures and as approved by the U.S. Postal Service in the Solid Waste Management and Environmental Protection Plan.

END OF SECTION

SECTION 028233

REMOVAL AND DISPOSAL OF NON-FRIABLE ACM

PART 1 - GENERAL

1.1 SUMMARY

A. Removal and disposal of non-friable asbestos-containing materials related to roof replacement, piping insulation, and exhaust flue.

1.2 RELATED SECTIONS

A. Section 013543 – Environmental Procedures
B. Appendix A – ACM Report

1.3 QUALITY ASSURANCE PROCEDURES

A. Immediately refer any conflicts between the requirements outlined in this Section and those of regulatory agencies to the Owner for resolution.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.1 GENERAL

A. Refer to the laboratory report located in Appendix A for location of ACMs identified during sampling. Removal or disturbance of these areas associated with the work will require compliance with this section. Contractor shall make every attempt to avoid disturbing these areas, which are identified in the field.

B. Complete PS Form 8210 – Work Authorization – Asbestos. Refer to Section 013543, Sub-paragraph 1.5.H, and the attached form and instructions.

C. Removal of identified ACM shall be performed by contractor personnel trained for such removal. Prior to work start, the contractor shall provide an ACM removal plan, identifying ACM components to be removed, personnel performing the work, documentation of training provided to personnel performing work, methodology for custody, handling and disposal of ACM, and the schedule for performing removal work. Maintain this documentation on-site. The contractor shall provide all necessary labor, materials, equipment and transportation to perform ACM removal work.

D. The contractor shall maintain a contact person on-site during work.

E. If additional suspect ACMs are uncovered, other than those indicated in the report in Appendix A, the contractor shall notify the Contracting Officer immediately.

F. The contractor shall provide necessary permits and/or licenses necessary for ACM removal.

G. The contractor shall comply with all applicable local, state, federal, and Owner-mandated regulations and requirements related to removal of ACM.

H. Remove identified ACMs, following all applicable federal, state, local, and Owner-mandated requirements identified in Section 013543 for removal, handling, and disposal of non-friable ACMs. Dispose of ACMs as required by these regulations and requirements.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 REFERENCES

A. General:

1. The publications listed below form a part of this specification to the extent referenced.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used

B. Unless otherwise shown or specified, the work shall conform to the following standards and recommendations of the American Concrete Institute (ACI), latest editions adopted:

1. ACI 117, “Standard Specification for Tolerances for Concrete Construction and Materials.”
2. ACI 121R, “Quality Assurance Systems for Concrete Construction.”
3. ACI211.1, “Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
4. ACI 212.2R, “Guide for Use of Admixtures in Concrete.”
5. ACI 214, “Recommended Practice for Evaluation of Strength Test Results of Concrete.”
6. ACI 301, “Specification for Structure /Concrete.”
7. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
8. ACI 304R, “Guide for Measuring, Mixing, Transporting, and Placing Concrete.”
9. ACI 304.2-R, "Placing Concrete by Pumping Methods."
10. ACI 305, “Hot Weather Concreting.”
11. ACI 306, “Cold Weather Concreting.”
12. ACI 306.1 “Standard Specification for Cold Weather Concreting.”
13. ACI 308, “Standard Practice for Curing Concrete.”
14. ACI 309R, “Guide for Consolidation for Concrete.”
15. ACI 315, “Details and Detailing of Concrete Reinforcement.”
16. ACI 318, “Building Code Requirements for Structural Concrete.”
17. ACI 347, “Guide to Formwork for Concrete.”
18. ACI 347.2R “Guide for Shoring/Reshoring of Concrete Multistory Buildings.”
19. ACI 503.2, “Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.”
20. ACI SP-15, "Field Reference Manual" which includes ACI 301 "Specifications for Structural Concrete for Buildings" and reference standards specified therein.

C. American Welding Society (AWS)

1. AWS D1.4, "Structural Welding Code Reinforcing."

D. American Society for Testing and Materials (ASTM).

1. ASTM A615, "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."
2. ASTM C31, “Standard Practice for Making and Curing Concrete Test Specimens in the Field.”
3. ASTM C33, "Standard Specification for Concrete Aggregates."
4. ASTM C39, "StandardTest Method for Compressive Strength of Cylindrical Concrete Specimens."

5. ASTM C42, “Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.”
6. ASTM C94, "Standard Specification for Ready-Mixed Concrete."
7. ASTM C109, “Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)”
8. ASTM C114, "Standard Test Method for Chemical Analysis of Hydraulic Cement."
9. ASTM C138, "Standard Test Method for Unit Weight, Yield, and Air Content of Concrete (Gravimetric) of Concrete."
10. ASTM C143, "Standard Test Method for Slump of Hydraulic Cement-Cement Concrete."
11. ASTM C150, "Standard Specification for Portland Cement."
12. ASTM C156, "Standard Test Method for Water Retention by Concrete Curing Materials."
13. ASTM C171, "Standard Specification for Sheet Materials for Curing Concrete."
14. ASTM C173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
15. ASTM C231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
16. ASTM C260, "Standard Specification for Air Entraining Admixtures for Concrete."
17. ASTM C309, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.”
18. ASTM C311, “Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.”
19. ASTM C387, "Standard Specification for Packaged, Dry, Combined Materials for Mortars and Concrete."
20. ASTM C457, “Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete.”
21. ASTM C494, "Standard Specification for Chemical Admixtures for Concrete."
22. ASTM C618, "Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."
23. ASTM C920, “Standard Specification for Elastomeric Joint Sealants.”
24. ASTM C685, "Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.”
25. ASTM C989, “Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.”
26. ASTM C1260, “Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).”
27. ASTM C1567, “Standard Test Method for Potential Alkali Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).”
28. ASTM E154, "Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Slabs, On Walls, or as Ground Cover.”
29. ASTM E1155, “Standard Test Method for Determining F Floor Flatness and FL Floor Levelness Numbers”
30. ASTM D2240, “Standard Test Method for Rubber Property-Durometer Hardness.”

E. Concrete Reinforcing Steel Institute (CRSI),

1. CRSI "Manual of Standard Practice.”

1.2 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.

1. Review of submittals will cover general design only. In no case shall submittal review relieve the Contractor of the responsibility for strength of concrete, general or detailed dimension, quality or quantity of materials, or any other conditions, functions, performance or guarantees required.
2. Product Data:

a. Manufacturers' literature containing product and installation specifications and details.
b. Where Manufacturer's specifications, recommendations, and/or directions are required in this specification, deliver to the Contracting Officer two (2) copies of such printed specifications, recommendations, and/or directions for approval before any work is commenced.
c. Sources of fine and coarse aggregate. Once approved, the source of fine and coarse aggregate shall not be changed without written approval of the Engineer.
d. List of manufacturers and brand names for cement, mineral and liquid admixtures, bond breakers, curing compounds, joint sealants, and materials other than aggregates and reinforcing steel. Include product data sheets, instructions, and specifications for use.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Deliver materials in unopened containers with labels identifying contents.

C. Store powdered materials in dry area and in manner to prevent damage. Protect liquid materials from freezing or exceeding maximum storage temperatures set by product manufacturer.

1.5 PROJECT CONDITIONS OR SITE CONDITIONS

A. Jobsite Requirements:

1. Conform to ACI 305 R when placing concrete during hot weather.
2. Conform to ACI 306 R when placing concrete during cold weather.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Concrete:

1. Concrete shall be in accordance with ASTM C94. If a conflict exists between ASTM C94 and these specifications, these specifications shall govern.

B. Portland Cement: ASTM C150 – Type I unless otherwise specified or approved by the Engineer.

1. Assume full responsibility for the quality and soundness of cement. Cement is to be of one type and from the same mill; it is to be of uniform color for all concrete with permanently exposed concrete finishes.

C. Liquid admixtures: All admixtures shall be used in conformance with the manufacturer's recommendations. When air entraining admixtures, water reducing admixtures, high range water reducing admixtures, and non-corrosive accelerating admixtures are used in any combination, all products shall be from the same manufacturer or the ready-mix concrete producer shall certify that they are compatible. The following admixtures are permitted when approved in writing prior to use or are required as specified herein and shall be used in strict accordance with the manufacturer's specifications or recommendations:

1. Calcium chloride: Conform to ACI 301. The water-soluble chloride ion level shall not exceed 0.3 percent by weight of cement.

2. Air-entraining admixtures: ASTM C260 shall be used to achieve the specified air content in all permanently exposed exterior concrete. For steel hard trowel interior slab finish, do not use air entrainment admixtures. The total air entrainment (entrained and entrapped air) must not exceed 3 percent. For steel trowel exterior slab finish, comply with ACI 318 and ACI 302.
   a. Euclid: AEA-92 or Air Mix 200.
   b. BASF: Micro-Air, MBVR-Standard, and MB AE 90.
   c. Sika: Sika AEA-14, Sika AEA-15, and Sika Air.
   d. W.R. Grace: Darex EH, Darex II AEA, Daravair AT60, Daravair 1400, and Daravair 1000.

3. Water-reducing admixtures: Conform to ASTM C494, Type A, containing not more chloride ions than allowed in paragraph C., above.
   a. Euclid: Eucon WR series or Eucon MR.
   b. BASF: Masterpave, Masterpave N, PolyHeed 997, Pozzolith 220N, and Glenium 7500.
   c. W.R. Grace: Daracem 55 and Daracem 65, WRDA 82 and WRDA with HYCOL.
   d. Sika: Sikament HP, Plastocrete 161, and Sikament 686.
   e. General Resource Technology: Polychem 400 NC and Polychem 1000.

4. Water-reducing/accelerating admixtures: Conform to ASTM C494, Type C or E having long-term test results showing non-rusting on metal deck and reinforcing steel.
   a. Euclid: Accelguard series.
   b. BASF: Pozzutec 20+, Pozzolith NC 534, and Rheocrete CNI.
   c. Sika: Sika Rapid-1 and Plasocrete 161FL.
   d. W.R. Grace: Lubricon NCA, Polarset, and DCI.

5. Water-reducing/retarding admixtures: Conform to ASTM C494, Type D containing not more than 1 percent chloride ions.
   a. Euclid: Eucon Retarder series.
   b. BASF: Delvo Stabilizer, Masterpave series, and Pozzolith 100XR, 200N, 220N and 322N.
   c. Sika: Plastimet.
   d. W.R. Grace: Daratard 17, WRDA-64, and WRDA-82.

6. High-range/water-reducing (HRWR) admixtures: Conform to ASTM C494, Type F or G super plasticizers containing 1 percent maximum chloride ions may be used with low slump (3 inches maximum) concrete to produce flowable concrete (up to 8 inches slump) with early strength gain and 28-day strengths equal to reference concrete. HRWR admixture may be used providing not more than 60 minutes is allowed from addition of admixture to final placement of concrete. HRWR admixture shall be used in concrete with a maximum water/ cement ratio of 0.50 or less and is suggested in the following:
   a. In pumped concrete.
   b. In concrete topping slabs
   c. In lieu of the specified water-reducing admixture (Type A) where confinement of placing due to heavy reinforcement or narrow space requires flowable concrete.
   d. Where more than 30 minutes is required between the addition of admixtures to final placement of the concrete, a combination of water-reducing, set controlling admixtures (ASTM C494, Types A, D, & E) as in Master Builders Company "Synergized Performance System" may be used.

1) Euclid: Eucon 37 or Eucon 537.
2) BASF: Rheobuild 1000, Glenium 3000 NS, and Glenium 3400NV.
3) Sika: Sikament 300, Viscocrete 2100, and Sikament 686.
4) W.R. Grace: Daracem 100, ADVA Cast 530, Mira 92, and ADVA Cast 575.

D. Fly ash: Conform to ASTM C618. The use of a quality fly ash will be permitted as a cement-reducing admixture (minimum 15 percent and maximum 25 percent). Fly ash used in concrete shall be from a single source and of a single class in combination with Portland cement of a single source and single class unless otherwise approved by the Engineer. The fly ash shall meet all of the requirements of ASTM C618, Class C or Class F, with the following special requirements: The loss on ignition in Table 1 shall not exceed 3 percent. Compliance to Table 1A shall apply. The amount retained on the 325 sieve in Table 2 shall not exceed 34 percent. Where a Type II low-alkali cement is specified, the total C_3A shall be less than 8 percent of total cementitious material. The chemical analysis of the fly ash shall be reported in accordance with ASTM C311. Quality assurance testing and reports for a minimum of six months shall be submitted by the fly ash supplier. The option to use fly ash must be approved prior to use.

E. Certification: Certification of the above requirements is required from the admixture manufacturer prior to mix design review and approval by the Contracting Officer. Upon request by the Contracting Officer, a qualified representative is to be provided to assure proper use of admixtures. Use of admixtures, other than listed above will be permitted only when approved.

F. Aggregates:

1. Normal-weight concrete - ASTM C33. For slabs, also conform to combined aggregate grading recommendations of ACI 302 and ACI 302.1R, unless otherwise permitted.
2. All concrete exposed to the weather shall conform to the limits of deleterious substances and physical properties of Table 3, ASTM C 33.
3. Local aggregates: Local aggregates not complying with ASTM C33, but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Contracting Officer.
4. The nominal size of an aggregate particle shall not exceed:

    a. 20 percent of the narrowest dimension between sides of forms.
    b. 33 percent of the depth of slabs.
    c. 75 percent of the dimension between reinforcing bars.
    d. 75 percent of the dimension between reinforcing bars and forms.

5. Maximum size of coarse aggregates and minimum cementitious contents: ACI 301 and ACI 302.1R.
6. Concrete aggregate alkali-silica reactivity (ASR) shall be tested in accordance with ASTM C1260 with a 14-day expansion (no supplementary cementing materials) or ASTM C1567 (with supplementary cementing materials) of less than 0.1 percent. Materials (cement, supplementary cementing materials, and aggregates) to be used in the concrete shall be tested. Coarse aggregates and fine aggregates shall be individually tested. If two grades of coarse aggregates are blended they shall be individually tested.
7. Abrasive aggregates non-slip finishes: Fused aluminum oxide grits, or crushed emery, as abrasive for non-slip finish with emery aggregate containing not less that 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof, non- glazing, and unaffected by freezing, moisture, and cleaning materials.

G. Water:

1. Clean, potable, and free of injurious amounts of oil, acid, alkali, organic or other deleterious matter not detrimental to concrete; drinkable.

2. Water shall contain no more than 650 parts per million of chlorides as Cl or more than 1000 parts per million of sulfates as SO_4. In no case shall the water contain an amount of impurities that will cause a change in the setting time of Portland cement of neither more than 25 percent nor a reduction in compressive strength of mortar at 14 days of more than 5 percent when compared to the results obtained with distilled water when tested in accordance with ASTM C109.
3. Water used for curing shall not contain impurities in amounts to cause discoloration of the concrete or mortar or to produce etching of the surface.
4. Recycled water shall conform to ASTM C94.

2.2 CURING/SEALING/HARDENERS

A. Dissipating liquid membrane-forming compounds for curing concrete; Conform to ASTM C309, Type 1. Curing compound shall be compatible with floor sealer or finish used. Low VOC.

1. Euclid: VOX Kurex DR VOX series; waterborne products.
2. W.R. Meadows: 1100-Clear series.
3. Edoco: Burke Aqua Resin Cure.
4. L&M Construction Chemicals: Cure R.
5. BASF: Kure 200W
6. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Method of curing shall be approved by the finish flooring applicator where finishes are indicated.

C. Exterior Sealers: applied to horizontal concrete surfaces permanently exposed to salts, deicer chemicals and moisture, including parking decks. The manufacturer shall provide a five-year labor and materials warranty on performance of the sealer. Sealer shall be compatible with the curing compound used.

1. Euclid: Eucoguard or Diamond Clear or Super Diamond Clear.
2. ChemREX: Hydrozo Clear 40.
3. Substitutions: Permitted.

D. Liquid Densifier/Sealer/Hardener: to be applied on exposed concrete floors cured with dissipating membrane forming curing compound to harden and densify concrete surfaces. Sealers are to be clear, chemically reactive, a waterborne solution of silicate or siliconate materials and proprietary components, odorless, and colorless.

1. ChemMasters: Chemisil Plus
2. Conspec Marketing and Manufacturing Co., Inc. Intraseal
3. Euclid Chemical Company: Euco Diamond Hard (Liquid Sealer and Hardener)
4. L&M Construction Chemicals: Seal Hard (Liquid Sealer and Hardener)
5. Curecrete Chemical Company: Ashford Formula (Liquid Sealer and Hardener)
6. W.R. Meadows, Inc.: Liqui-Hard
7. Sika: Sikafloor 3S
8. Sonneborn: Kure-N-Harden
9. Symons Corporation: Buff Hard
10. Or approved equal.

2.3 PROPORTIONING

A. Concrete types and strengths: Minimum 28 Day Compressive Strength shall be per design requirements but not less than:

1. Concrete: 3,500 psi.
2. All concrete exposed to weather shall be air entrained (ASTM C260).
3. All concrete shall be normal weight.

When the concrete mix design is developed from laboratory trial batching, adjust proportions to produce a design mix at least 1200 psi greater than the specified strength.

When the field experience method is used, the required average compressive strength shall be determined in accordance with ACI 318.Documentation that proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength shall consist of a field strength test record representing materials and proportions to be used for this project. A field strength test record shall consist of at least 10 consecutive tests encompassing a period of time of not less than 45 days and made within the past 12 months.

Also, see general and specific notes on structural drawings.

B. Weights: All concrete shall be normal-weight concrete unless otherwise designated on the structural drawings.

C. Aggregate gradation: For slabs, also conform to combined aggregate grading recommendations of ACI 302.1R, unless otherwise permitted. For all other concrete not otherwise noted the coarse aggregate gradation shall conform to ASTM C33 size no. 57 or larger.

D. Durability: Conform to ACI 301.

1. All concrete exposed to potentially destructive weathering, such as freezing and thawing, or to de-icer chemicals is to be air-entrained, 6 percent $\pm$1percent, a minimum six sacks cementitious per cubic yard of concrete, 0.45 maximum water-cementitious ratio, and, 4-inch maximum slump.
2. Water-cement ratio: For concrete subject to freezing and thawing or deicer chemicals, the water-cement ratio shall not exceed 0.53 by weight including any water added to meet specified slump in accordance with the requirements of ASTM C94 unless otherwise noted.

E. Slump: Conform to ACI 301.

1. 3 ½ inch maximum for consolidation by vibration
2. 5 inch maximum for consolidation by other methods
3. 8 inch maximum for flowable concrete. Concrete containing HRWR admixture (super plasticizer): 3 inch maximum before addition of HRWR
4. Where field conditions require slump to exceed that specified above, the increased slump shall be obtained by the use of a superplasticizer only, and the Contractor shall obtain written approval from the Contracting Officer who may require an adjustment to the mix.

F. Production of concrete: Conform to ACI 301:

1. Cast-in-place concrete used in the work shall be produced at a single off-site batching plant or may be produced at an on-site batch plant.
2. All concrete shall be proportioned conforming to the approved mix designs and of the materials contained in those approved mixes. A certified copy of the design weights for each mix shall be kept at the producing plant for each class of concrete used on the project.
3. Plant equipment and facilities are to conform to the "Check List for Certification of Ready -Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association (NRMCA) and have NRMCA or approved certification within the past year.
4. Coarse aggregates shall be washed and, if necessary, shall be uniformly moistened just before batching. Each size of coarse aggregate shall be batched from separate bins as required to produce the combined grading requirements.
5. Prior to adding a high-range water reducer (super plasticizer), slump shall not exceed the working limit. The high-range water reducing admixture shall be accurately measured and pressure-

injected into the mixer as a single dose. If added at the jobsite, the field dispensing system shall conform to the same requirements as a plant system and tested prior to each day's operation. After the addition of the high-range water reducer, the concrete shall be mixed at mixing speed for a minimum of 5 minutes.

6. Ready-mixed and on-site batched concrete shall be batched, mixed, and transported in accordance with ASTM C94.

    a. Truck mixers and their operation shall ensure that the discharged concrete is uniformly within acceptable limits of consistency, mix, and grading. All mechanical details of the mixer, such as water-measuring and discharge apparatus, conditions of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum shall be checked before the use of the unit will be permitted.
    b. Truck mixers shall be equipped with approved revolution counters by which the number of revolutions of the drum or blades may readily be verified. The water tank system of the truck shall be equipped with gauges that permit accurate determination of the tank contents.
    c. Each batch of concrete shall be mixed in a truck mixer for not less than 80 revolutions of the drum or blades and at the rate of rotation designated as mixing speed by the manufacturer of the equipment. Additional mixing, if any, shall be at the speed designated as the agitating speed by the manufacturer of the equipment. All materials, including mixing water but excluding any high-range water reducers added onsite, shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
    d. The concrete producer shall furnish duplicate delivery tickets, one for the Contractor and one given to the Owner's Representative for each batch of concrete. The information provided on the delivery ticket shall include the quantity of materials batched including the amount of free water in the aggregate and any water added onsite. Show the date, time of day batched, and if ready-mixed the time of discharge from the truck. The quantity of water that can be added at the site without exceeding the maximum water-cementitious ratio specified shall be noted on the delivery ticket.

7. The Engineer may increase the mixing time when the charging and mixing operations fail to produce a delivered batch in which variations of consistency, mix, or grading are within the limits specified.
8. Variations in consistency during the discharge of a single batch shall not exceed 1 inch of slump, except that a greater variation will be permitted if the slump of the concrete decreases and no water is added. Variations in mix and in grading of different parts of the delivered batch shall be within limits stated in ASTM C94.
9. Water shall be introduced prior to, during, and following mixer-charging operations.
10. When a mixer produces unsatisfactory results, it shall be repaired promptly and effectively, or it shall be replaced.
11. Mixers shall not be loaded in excess of their rated capacity.
12. Overmixing, such as to require addition of water to preserve the required consistency or to reduce slump, will not be permitted.
13. All other concrete: Conform to ACI 301
14. Use of accelerating admixtures in cold weather and retarding admixtures in hot weather shall not relax placement requirements specified herein.
15. All concrete placed at ambient temperatures below 50 degrees F is to contain an approved accelerator. The concrete temperature when delivered at the site shall be at least 50 degrees F.
16. All concrete placed at ambient temperatures above 80 degrees F is to contain an approved retarder.
17. All concrete required to be air-entrained is to contain an approved air-entraining admixture.
18. When improved workability, pumpability, lower water-cement ratio, or high ultimate and/or early strength is required, the HRWR admixture (super plasticizer) may be used.
19. Ensure air content for slabs with steel trowel finish is less than 3.0 percent.
20. The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around reinforcement without permitting materials to segregate or free water to collect on the surfaces. Within the limiting requirements, adjust the

consistency of the concrete as may be necessary to produce mixtures which will be placeable with reasonable methods of placing and compacting. Maintain on the job at all times adequate extra cement to be used at rate of 1/2 sack cement per cubic yard concrete for each 2" slump increase for corrections due to wetness desired or obtained. No water shall be added to concrete except under the direct awareness of the project inspector.

21. No water shall be added to concrete except under the direct awareness of the project inspector. The water-cementitious ratio stated on the approved mix designs shall not be exceeded unless approved by the Engineer. Re-tempered concrete shall be mixed for not less than 80 revolutions of the drum or blades and at the rate of rotation designated as mixing speed by the manufacturer of the equipment.
22. Adjustments to concrete mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant at no additional cost to Contracting Officer. Laboratory test data for revised mix design and strength results must be submitted and accepted before using in work.

2.4 REINFORCING MATERIALS

A. Concrete Reinforcement

1. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION - GENERAL

A. Install all cast-in-place concrete work in accordance with ACI 301 except as herein specified.
B. Immediately before placing concrete, spaces to be occupied by concrete shall be free from standing water, ice, mud, and debris.
C. Concrete shall not be deposited under water or where water in motion may injure the surface finish of the concrete.
D. Immediately before placing concrete for exterior sidewalk, curb and gutter, pavements, and slab-on-grade, subbases and compacted subgrades shall be thoroughly moistened, but not muddied, by sprinkling with water. Surfaces shall be kept moist by frequent sprinkling, as required, up to the time of placing of concrete.
E. Forms and the reinforcement shall be thoroughly cleaned of ice and other coatings. Remove surplus form releasing agent from the contact face of forms.

F. Notify all trades concerned and the Owner's Representative sufficiently in advance of the scheduled time for concrete placement to permit installation of all required work by other trades.
G. Before placing concrete, all required embedded items, including dovetail anchor slots, anchors, inserts, curb angles, metal frames, fixtures, sleeves, drains, stair nosings, accessory devices for Mechanical and Electrical installations shall be properly located, accurately positioned and built into the construction, and maintained securely in place.
H. Build into construction all items furnished by the Owner and other trades. Provide all offsets, pockets, slabs, chases and recesses as job conditions require.
I. Place and properly support reinforcing steel and anchor bolts.
J. The alignment, orientation, spacing, and embedment length of mechanical load transfer devices in slab-on-grade and pavements shall conform to dimensions and tolerances shown on the drawings.
K. The Contracting Officer Representative should attend the first concrete pour.

3.3 METHODS OF PLACEMENT AND PLACING CONCRETE

A. Placement: Conform to ACI 301:

1. Maintain concrete cover around reinforcing as per Section 3.3 above and ACI 301.
2. The methods and equipment used for transporting concrete to the site work and the time that elapses during transportation shall not cause segregation of coarse aggregate or slump loss in excess of 1 inch when measured at the point of discharge.
3. Concrete shall be placed within 90 minutes after the water has been added to the cement and aggregates. Concrete shall be placed prior to initial concrete set.
4. Placing of concrete will not be permitted during rainfall or when rain appears imminent. If rain should fall subsequent to placement, the concrete shall be completely protected until curing is complete.
5. Cold-Weather Placement: Comply with provisions of ACI 306.1 "Standard Specifications for Cold-Weather Concreting" and as follows.

    a. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
    b. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature during the first 24 hours.
    c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
    d. Concrete shall not be placed on frozen ground or placed when the ambient temperature is 40 deg F or less and dropping.
    e. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
    f. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures using vented heaters and insulating blankets.
    g. Vent heater exhaust gases that contain carbon dioxide outside of enclosed areas.
    h. Concrete temperatures shall be maintained above 50 degrees F for the first 7 days of curing.

6. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305R "Standard Specification for Hot-Weather Concreting" and as specified.

    a. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice of a size that will melt completely during mixing may be used to control temperature, provided water

equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

b. Reject any concrete that has a temperature at the point of placement above 90 deg F, unless approved otherwise by the Construction Project Manager. When air temperatures are between 80 and 90 deg F the maximum mixing and delivery time is reduced to 75 minutes. When air temperatures exceed 90 deg F, the maximum mixing and delivery time is reduced to 60 minutes.

c. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

d. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

e. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Contracting Officer.

f. Spray evaporative retardants, wind breaks, misters, or shade concrete when the rate of surface evaporation when calculated in accordance with ACI 305.5 exceeds 0.2 lb/sq. foot per hour.

B. Depositing Concrete

1. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Hoppers, tremies, pump line, ducts, chutes, or other methods approved by the Engineer shall be used to deposit concrete in its final position within the specified time limits and without segregation of the mix.
2. The sequence of concrete placement and the number, type, position, and design of joints shall be approved by the Engineer prior to concrete placement.
3. Place floor slabs-on-grade by "strip cast" method.
4. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to re-handling or flowing. No concrete shall have a free fall of over three feet from truck, mixer, or buggies.
5. The concreting shall be carried on at such a rate that the concrete is plastic at all times and flows readily into the spaces between reinforcing bars. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited in the work
6. When concreting is started, it shall be carried on as a continuous operation until the placing of the section is completed.
7. Except as intercepted by joints, concrete shall be placed in continuous layers. The depth of layers shall not exceed 20 inches. Succeeding layers shall be placed while the previous layer is still plastic. Concrete placement shall begin at the lowest point in each section of concrete to be placed.
8. Protect adjacent surfaces from concrete drippings, spillage, and splashes. Hardened or partially hardened splashes or accumulations of concrete on forms or reinforcement shall be removed before the work proceeds. Clean all damaged surfaces immediately.
9. All conveyances shall be thoroughly cleaned at frequent intervals during the placement of the concrete, and before the beginning a new run of concrete all hardened concrete and foreign materials shall be removed from the surfaces.
10. The Superintendent of Foreman in charge of concrete work shall mark on the drawings the time and date of the placing of each concrete pour. Locations where concrete test cylinders are made shall also be noted on the drawings. Such drawings shall be kept on file at the job until its completion and shall be subject to the inspection of the Owner’s Representative at all times.

C. Conveyor Belts and Chutes

1. Chutes or conveyor belts shall not be used except as approved by the Engineer.
2. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent separation and loss of material.
3. Chutes longer than 50 feet and conveyor belts longer than 110 feet will not be permitted.

4. Equipment for conveying and chuting concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery point without separation of material.
5. Provide runways or other means for wheeled equipment to convey concrete to point of deposit. Construct runways so that supports will not bear upon reinforcement or fresh concrete.
6. The minimum slope of chutes shall enable concrete of the specified consistency to readily flow.
7. Ends of chutes, hopper gates, and other points of concrete discharge throughout the conveying, hoisting, and placing system shall be designed and arranged so that concrete passing from them will not fall separated into whatever receptacle immediately receiving the concrete. Adequate headroom provision must be made at such points for a vertical drop and for proper baffling.
8. If a conveyor belt is used, it shall be wiped clean by a device operated so that none of the mortar adhering to the belt will be wasted.

D. Consolidation

1. All concrete shall be thoroughly consolidated by internal mechanical vibrators during the placing operation and shall be thoroughly worked around the reinforcement and embedded fixtures and into corners of the forms.
2. Concrete for slabs 8 inches thick or less may be consoldated with vibrating screeds. Slabs between 8 to 12 inches thick shall be compacted with internal vibrators and (optionally) with vibrating screeds.
3. Concrete shall be consolidated by vibration to the maximum practicable density. The concrete shall be free from pockets of coarse aggregate and entrapped air.
4. Vibrators shall have a minimum diameter of 3 inches with a frequency of at least 7000 vibrations per minute and with an amplitude adequate to consolidate the concrete in the section being placed.
5. Forms shall contain sufficient windows or shall be limited in height to allow visual observation of the concrete during placement. Sufficient illumination shall be provided in the interior of forms so that at the places of concrete deposition the concrete shall be visible from the deck or runway.
6. Vibrators shall not be secured to forms or reinforcement.
7. Keep a minimum of two standby vibrators in operable condition on the job during concreting operations.
8. Consolidation shall be carried on continuously with the placing of concrete.
9. The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it is deposited in the forms.
10. When consolidating each layer of concrete, the vibrator shall be operated at regular and frequent intervals 18 to 30 inches apart.
11. The vibrator shall be kept in nearly a vertical position as practible. The use of vibrators to shift or drag concrete after deposition will not be permitted. Vibrators shall not be laid horizontally or laid over.
12. The vibrator head shall penetrate 6 to 8 inches into the preceding layer and then be withdrawn at a slow rate. The top part of each layer shall be re-vibrated systematically at the latest time the concrete can be made plastic by means of vibration.
13. Concrete shall not be placed until the previous layer has been vibrated.
14. Unless directed otherwise by the Engineer, the top 2 feet of walls shall be re-vibrated approximately 1 hour after placement of concrete and while a running vibrator will still sink under its own weight into the concrete and liquefy it momentarily.

E. Protection of cast concrete: Conform to ACI 301.
F. Repair of surface defects: ACI 301.

1. Inspect concrete surfaces and surfaces to be painted immediately upon removal of forms Irregularities shall be immediately rubbed or ground to secure a smooth, uniform, and continuous surface.
2. Clean surfaces of tie holes. Tie holes shall be filled solid with patching mortar.
3. Surfaces to be smoothed shall not be plastered or coated.

4. Patch imperfections as needed or as directed by the Contracting Officer. Repairs in accordance with Section 3.8 shall not be made until the surface has been inspected and repair methods have been approved by the Contracting Officer.

3.4 FINISHING

A. Finishing of formed surfaces: ACI 301:

1. Tops of forms:

   a. Strike concrete smooth at tops of forms.
   b. Float to texture comparable to formed surfaces.

2. Formed surfaces:

   a. Finished formed surfaces shall conform accurately to the shape, alignment, grades, and sections shown on the drawings or prescribed by the Engineer.
   b. Surfaces shall be free from fins, bulges, ridges, honeycombing, or roughness of any kind and shall present a finished, smooth, continuous hard surface.
   c. Permanently exposed surfaces: ACI 301 - "Smooth Form Finish" with the fins ground smooth and air holes shall be filled with a non-shrink mortar. The color of the patch material shall match the color of the surrounding concrete. Surfaces in unfinished areas unexposed to public view: ACI 301- "Rough Form Finish".

3. Concrete Finishes:

   a. Steel trowel finish. As soon as the moisture sheen has disappeared from the floated surface and he concrete has hardened sufficiently to prevent drawing moisture and fine materials to the surface, the surface shall be steel troweled to produce a smooth, hard, uniform finish. Final steel troweling shall be conducted after the concrete is hard enough that no mortar accumulates on the trowel when manipulated with heavy pressure.
   b. Finish with a broom finish.

3.5 CURING, PROTECTION, LIQUID HARDNERS AND SEALERS

A. Temperature, Wind, and Humidity

1. When concrete slabs and other unformed concrete is placed in warm, dry, dusty, or windy conditions, concrete surfaces shall be protected from rapid drying by use of windbreaks, shading, fogging with properly designed nozzles, or a combination of these measures. Hot weather concreting procedures provided in ACI 305R shall be used when ambient conditions dictate.
2. Cold weather concreting procedures provided in ACI 306R shall be used when ambient conditions dictate.
3. Changes in air temperature immediately adjacent to the concrete during and immediately following the 7-day initial curing period shall be kept as uniform as possible and shall not exceed 5 deg. F in any 1 hour or 50 deg. F. in any 24-hour time period.

B. Curing Compound

1. Apply curing compound to all interior and exterior flat slab and vertical surfaces. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
2. All curing methods shall be placed immediately after final finishing (i.e., within two hours). Contractor's attention is directed to the fact that experience shows the most important time of curing is from three to four hours after placing and extending five to six hours thereafter. It is

extremely important, therefore, to prevent loss of moisture, particularly during this period when concrete is especially vulnerable to plastic shrinkage cracks. All exposed surfaces of concrete including floor slabs, whether or not they receive a finish flooring, shall be protected from premature drying for a minimum of seven days.

3. Apply the specified curing compound in strict accordance with manufacturer's written instructions. Curing compound shall not be diluted by the addition of solvents or thinners, nor shall it be altered in any other manner. Curing compound that has become chilled and is too viscous for satisfactory application shall be heated by steam or hot water bath until it has proper fluidity. The temperature of the compound shall not exceed 100 ºF. Curing compound shall not be heated by direct exposure of the container to fire.
4. When used on an unformed concrete surface, application of the first coat of curing compound shall commence immediately after finishing operations have been completed. When curing compound is used on a formed concrete surface, the surface shall first be moistened with a fine spray of water immediately after the forms have been removed. The spray shall be continued until the surface does not readily absorb further water. As soon as the surface film of water has disappeared and the surface is almost dry, the first coat of curing compound shall be applied. In the event that application is delayed on either formed or unformed surfaces, the surface shall be kept continuously moist until the compound has been applied or the specified period of water curing has elapsed.
5. Surfaces shall be sprayed uniformly with 2 coats of curing compound. Each coat shall provide a minimum coverage of 1 gallon per 250 square feet of surface. As soon as the first coat has become dry, a second coat shall be applied in the same manner. The direction of application of the second coat shall be perpendicular to the first coat. The curing compound shall be sprayed using approved pneumatic or pump driven equipment having the following characteristics:

    a. Separate lines to the nozzle for material and for compressed air
    b. A filtering system for the removal or entrapment of contaminants
    c. A constant application pressure

C. Protection

1. Freshly placed concrete shall be protected against wash by rain.
2. Dust control shall be provided in the surrounding areas during placement. If, in the opinion of the Engineer, these conditions are not satisfactory met, concrete shall not be placed.
3. During the first 2-day period of curing, no traffic on or loading of the floors will be permitted.
4. The contractor shall allow no traffic and take precautions to avoid damage to the membrane of the curing compound for a period of not less than 28 days. Damage shall be repaired immediately to the satisfaction of the Engineer.
5. Special care shall be taken to prevent avoid damaging the surfaces and joints due to load stresses from construction equipment, heavy shock, and excessive vibration. During construction activities, concrete shall be protected against damage with plywood or other approved materials until final acceptance by the Engineer.
6. Precautions shall be taken to prevent overloading floors, pavements, slabs, beams, and other members. The Contractor shall comply with the Engineer's instructions regarding the loads that will be permitted on these members during construction.
7. Self-supporting structures shall not be loaded in such a way to overstress the concrete.

3.6 PATCHING AND REPAIR

A. Concrete will be considered by the Engineer as not conforming to the intent of the drawings and specifications for the following reasons:

1. Concrete this is not formed as shown on the drawings.
2. Concrete this is not in true alignment or level.
3. Concrete which exhibits a defective surface.
4. Concrete with defects that reduce the structural integrity of a member or members.

5. Concrete jointed slabs with uncontrolled random cracking.

B. Non-conforming concrete to required thickness, lines, details, and elevations will be rejected by the Contracting Officer and shall be modified or replaced with concrete that conforms to the contract requirements without a claim by the Contractor for additional cost or extension of contract time.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Contracting Officer for each individual area. Should the Contracting Officer grant permission for the Contractor to attempt restoration of a defective area by patching or other repair methods, such permission shall not be considered a waiver of the Contracting Officer's right to require complete removal of the defective area if, in the Engineer's opinion, the restoration does not provide the structural or aesthetic integrity of the member or members.

D. All repairs of defective areas shall conform to ACI 301. On areas requiring treatment of defects and until such repairs have been completed, only water cure will be permitted

E. At any time prior to final acceptance, concrete found to be defective, damaged, or not in accordance with the specifications shall be repaired or removed and replaced with acceptable concrete.

F. If approved by the Contracting Officer, repair or replace concrete with excessive honeycombing due to improper placement.

1. Honeycombed areas shall be removed down to solid concrete a minimum of 1 inch over the entire area. Feathered edges will not be permitted. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut.
2. Laitance and soft material shall be removed prior to patching with a pea gravel concrete mix and bonding agent approved by the Engineer.
3. The area to be patched and an area at least 6 inches wide surrounding it shall be dampened to prevent absorption of water from the patching materials.
4. If a cement slurry bonding grout is approved, the heavy-cream consistency grout shall then be rigorously brushed into the surface. The concrete patch material shall be installed prior to the bonding grout skimming over or drying.
5. If approved, a bonding admixture, bonding compound, or epoxy adhesive may be used in strict accordance with the manufacturer's preparation and application recommendations. Comply with ACI 301 and ACI 503.2 for standard specifications for bonding plastic concrete to hardened concrete with a multiple component epoxy adhesive.
6. The repair concrete shall be thoroughly consolidated in place and struck off so as to leave the patch slightly higher than the surrounding surface. The concrete shall be left undisturbed for at least 1 hour to permit initial shrinkage then finished.
7. The patched area shall be kept damp for 7 days.
8. The color of the patch material shall match the color of the surrounding concrete. Repairs shall be made promptly while the base concrete is less than 28 days old
9. Metal tools shall not be used in finishing a patch in a formed wall that will be exposed.

G. Areas requiring patching shall not exceed 2 sq. ft. per 1000 sq. ft. of surface area and shall be widely dispersed. Areas showing excessive defects as determined by the Contracting Officer shall be removed and replaced.

H. High spots identified in the floor flatness and levelness survey may be removed with bump grinding. Areas to be ground shall not exceed more than 10 percent of any one slab nor more than 5 percent of the total slab-on-grade area. There are no limitations for exterior concrete pavement areas requiring grinding.

I. Random hairline cracks in up to 3% of the slab panels will be accepted. Cracks in these panels shall be routed and filled with semi-rigid joint filler. If more than 3% of panels contain cracks, the number of panels exceeding the 3% limit shall be demolished and replaced at the direction of the Contracting Officer, crack repairs will not be accepted. Any panels that contain cracks wider than 0.022" shall be demolished and replaced.

J. Interior slab-on-grade hairline cracks allowed to be repaired that are subjected to lift truck traffic shall be routed and sealed with a semi-rigid epoxy sealant. Exterior slabs may be routed and sealed with the flexible joint sealant to be installed in pavement joints.

3.7 MISCELLANEOUS CONCRETE

A. Equipment bases and foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

END OF SECTION

SECTION 040514

MASONRY MORTARING AND GROUTING

PART 1 - GENERAL

1.1 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM C 94 - Specification for Ready-Mixed Concrete.
   2. ASTM C 143 - Test Method for Slump of Hydraulic Cement Concrete.
   3. ASTM C 144 - Specification for Aggregate for Masonry Mortar.
   4. ASTM C 150 - Specification for Portland Cement.
   5. ASTM C 207 - Specification for Hydrated Lime for Masonry Purposes.
   6. ASTM C 270 - Specification for Mortar for Unit Masonry.
   7. ASTM C 387 - Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   8. ASTM C 404 - Specification for Aggregates for Masonry Grout.
   9. ASTM C 476 - Specification for Grout for Masonry.
   10. ASTM C 1019 - Method of Sampling and Testing Grout.
   11. ASTM C 1142 - Specification for Extended Life Mortar for Unit Masonry.

B. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

1.3 DELIVERY, STORAGE AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Store sand for mortar on plastic sheeting to prevent contamination by extraneous chemicals in earth beneath.

1.4 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements:
   1. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
   2. Specific Cold Weather Requirements: When the ambient air temperature is below 40 degrees F, heat mixing water to maintain mortar temperature between 40 degrees F and 120 degrees F until placed. When the ambient air temperature is below 32 degrees F, heat the sand and water to maintain this mortar temperature.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C 150, normal-Type I or Type II; gray color. Fly ash, slag, and pozzolans not permitted as substitutes for Portland cement.

B. Mortar Aggregate: ASTM C 144, standard masonry type; clean, dry, protected against dampness, freezing, and foreign matter.

C. Grout Aggregate: ASTM C 404; use of blast furnace slag is not permitted. Maximum coarse aggregate size, 3/8 inch.

D. Calcium chloride is not permitted in mortar or grout. Admixtures or other chemicals containing Thyocyanates, Calcium Chloride or more than 0.1 percent chloride ions are not permitted.

E. Hydrated Lime: ASTM C 207, Type S.

F. Water: Potable.

G. Admixtures: Not permitted unless approved by Contracting Officer prior to construction.

2.2 MIXES - MORTAR

A. Mortar: Type "N" or Type "S", as recommended by manufacturer, in accordance with the Proportion specification of ASTM C 270.
   1. Mixing of components on-site is acceptable.
   2. Mixing on-site water and packaged dry blended mix for mortar (ASTM C 387), that contains no masonry cement, is acceptable.

B. Pointing Mortar: Duplicate original mortar proportions. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 Percent of Portland cement weight.

C. Mortar Color: Match existing.

2.3 MIXING - MORTAR

A. Thoroughly mix mortar ingredients in accordance with ASTM C 270, in quantities needed for immediate use.
   1. Maintain sand uniformly damp immediately before the mixing process.
   2. Provide uniformity of mix and coloration.
   3. Do not use anti-freeze compounds.
   4. If water is lost by evaporation, retemper only within 2 hours of mixing. Do not retemper mortar more than 2 hours after mixing.

2.4 MIXES - GROUT FILL

A. Grout fill is for concrete masonry unit bond beams, lintels, and reinforced cells with reinforcing bars and embedded plates.
   1. Compressive Strength: 2000 psi minimum at 28 days, as determined in accordance with the provisions of ASTM C 1019.
   2. Slump: 8 inches, minimum; 10 inches, maximum, taken in accordance with ASTM C 143.

3. Use coarse grout when grout space is equal to or greater than 4 inches in both directions.
4. Use fine grout when grout space is smaller than 4 inches in either direction.
5. Do not use air-entrainment admixtures.

2.5 MIXING - GROUT

A. Grout: Batch and mix grout in accordance with ASTM C 94 or ASTM C476 for site batched and mixed grout. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION

A. After reinforcing of masonry is securely tied in place, plug cleanout holes with masonry units. Brace against wet grout pressure.

B. Install mortar and grout under provisions of Section 042100 and 042200.

END OF SECTION

SECTION 042100

CLAY UNIT MASONRY

PART 1 - GENERAL

1.1 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A153, "Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware."
   2. ASTM C5, "Specification for Quicklime for Structural Purposes."
   3. ASTM C144, "Specification for Aggregate for Masonry Mortar."
   4. ASTM C150, "Specification for Portland Cement."
   5. ASTM C207, "Specification for Hydrated Lime for Masonry Purposes."

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Materials shall be delivered and stored so as to avoid damage from breakage, moisture, staining or damage of any kind.

C. Storage of Materials: Store materials under cover in a dry place and in a manner to prevent damage or intrusion of foreign matter. During freezing weather protect all masonry units with tarpaulins or other suitable material. Store cement, lime and air-setting mortars in watertight sheds with elevated floors. Protect reinforcement from the elements; immediately before placing, reinforcement shall be free from loose rust, ice or other foreign coatings that will destroy or reduce the bond.

1.4 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements:
   1. No masonry work shall be installed in an atmosphere with temperature less than 40 degrees F. unless work is protected in a manner previously approved by the Contracting Officer.
   2. Hot Weather Construction - Protect masonry construction from direct exposure to wind and sun when erected in an ambient air temperature of 99 degrees F. in shade with relative humidity less than 50 percent.
   3. Cover work at end of each day's work with non-staining waterproof material so as to prevent entrance of excess water at top of wall.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Face Brick: Match existing.

B. Colored Mortar: Match existing.

C. Anchors and Ties: Anchors and ties shall be of zinc-coated steel or copper-coated steel. Except for steel wire, zinc coating shall conform to ASTM A153. Steel wire shall be zinc-coated in accordance with ASTM A116 for Class 2 coating. Provide anchors as required to securely attach to existing masonry.
   1. Anchor shall be DW-10 anchors as manufactured by Hohmann & Barnard, Inc., or approved substitution. Anchors shall be constructed of 12 Ga. hot-dipped galvanized steel. Average tensile load of the anchor shall be 128 lb. Ties shall be 3/16-inch Vees with a hot-dipped finish. Length of ties depends on the location of the substrate.

D. Embedded Flashing:
   1. Copper-Fabric laminate: 5 oz./sq. ft. copper sheet bonded with asphalt between 2 layers of glass-fiber cloth, as manufactured by AFCO Products, Inc.

E. Cavity Drainage Protection Mesh: Recycled polyester/polyethylene trapezoidal-shaped 90% open mesh. Thicknesses to fit wall in accordance with the manufacturer's recommendations. Height as recommended by manufacturer, but not to exceed height of the top of the flashing. Product as manufactured by Mortar Net USA, Limited.

F. Weep-hole Vent Filler: Three dimensional, ultraviolet resistant, weave of polyester. Size matching full head joint size of the masonry unit unless shown otherwise. Color selected by Contracting Officer to match mortar color. Product as manufactured by Mortar Net USA, Limited.

G. Masonry Cleaner: All masonry work shall be thoroughly cleaned with Vana Trol Sure Klean as manufactured by the Process Solvent Co., Inc. or approved substitution.

H. Mortar Materials: See Section 040514.

I. Mortar for Masonry Units: See Section 040514.

J. Mixing Mortar: See Section 040514

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 LAYING BRICK

A. Lay brick in accordance with detailed drawings, using continuous stretcher bond except where otherwise noted with veneer securely anchored to back-up masonry as described under anchors.

B. Lay all brick masonry straight, plumb and true to line with joints matching existing masonry.

C. Lay each brick in full joint of mortar on its bed and ends. Slush and fill each joint with mortar each course of brick as work progresses.

D. Take precautions to prevent mortar droppings in cavity or air space between face brick and concrete block. Install weep-hole ventilators at all waterproofed edges.

E. Anchor brick veneer at a minimum of 16 inches horizontally and 16 inches vertically.

F. Protect all freshly constructed masonry from injury of any kind. Replace injured work in a manner satisfactory to the Contracting Officer. Completely point and thoroughly wash all finished exposed masonry surfaces down with masonry cleaner in accordance with manufacturer's printed instructions.

3.3 JOINTS

A. Nominal thickness shall be 3/8 inch and uniform.

B. Shove vertical joints tight.

C. Strike joints flush in surfaces to be covered.

D. Tool joints slightly concave in surfaces to be exposed or painted.

3.4 BUILT-UP WORK

A. Cooperate with other trades in building in items in masonry work.

B. Grout solid around built-in items and in door frames.

3.5 LINTELS

A. Install rebars and grout solid as indicated. Provide temporary shoring for openings wider than 36 inches.

B. Lintels shall extend into side walls at jambs, minimum of 8 inches.

C. Coordinate steel lintels with Section 055000.

3.6 FLASHING, WEEP HOLES, VENTS

A. General: Install embedded flashing and weepholes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.

B. At masonry-veneer walls, extend flashing from exterior face of veneer, through the veneer, up face of sheathing at least 8 inches and behind air-infiltration/building paper.
   1. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. AT head and sills, extend flashing 4 inches at ends and turn up not less than 2 inches to form a pan.

2. Cut off flashing flush with face of wall after masonry wall construction is completed.

C. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing, and as follows:
   1. Space weep holes 24 inches o.c.
   2. In cavities, place pea gravel to a height equal to height of first course, but not less than 2 inches, immediately above top of flashing embedded in the wall, as masonry construction progresses, to splatter mortar droppings and to maintain drainage.

3.7 POINTING AND CLEANING

A. Dry brush masonry surfaces after mortar has set, at end of each day's work and after final points.

B. Cut out and repoint defective joints.

C. At final completion of masonry work, fill holes in joints and tool to match adjacent work.

D. Leave work and surrounding surfaces clean and free of mortar spots and droppings.

END OF SECTION

SECTION 042200

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 530 - Building Code Requirements for Masonry Structures.
   2. ACI 530.1 - Specifications for Masonry Structures.

B. American Society for Testing and Materials (ASTM):
   1. ASTM A 615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   2. ASTM C 55 - Specification for Concrete Brick.
   3. ASTM C 129 - Specification for Non-Load Bearing Concrete Masonry Units

C. International Masonry Industry All- Weather Council (IMIAC): Recommended Practices and Guide Specifications for Cold Weather Masonry construction.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

B. Qualifications:
   1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Materials shall be delivered and stored so as to avoid damage from breakage, moisture, staining or damage of any kind.

1.4 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements:
   1. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
   2. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Lightweight units used for non-load bearing walls, meeting requirements of ASTM C129, Type I. Provide units meeting fire resistance ratings.

B. Lightweight units used for load bearing walls, meeting requirements of ASTM C90, Grade N, Type I. Provide units meeting fire resistance ratings.

2.2 CONCRETE BUILDING BRICK

A. Concrete brick shall be solid units meeting ASTM C55, Type I, Grade N.

2.3 MORTAR

A. Specified in Section 040514.

2.4 REINFORCING

A. Horizontal reinforcing for concrete masonry units shall be mill galvanized, ladder type with 9 gauge parallel wires in each face and 9 gauge cross members a maximum of 24 inches on center, butt welded to side rods. Provide prefabricated corners and tees.

B. Reinforcing bars for lintels shall meet ASTM A615, Grade 60.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 PREPARATION

A. Provide temporary bracing during installation of masonry Work. Maintain in place until building structure provides permanent bracing.

B. Lay out work to avoid use of less than 8 inch x 8 inch faced units at jambs in exposed work.

C. Lintel block shall extend into side walls at jambs, at least 8 inches.

3.3 INSTALLATION

A. Mortar shall be thoroughly mixed and kept moist but shall not be retempered for use after initial set.

B. Lay only dry masonry units.

C. Use masonry saw for cutting exposed surfaces. Cut units to provide 1/8 inch clearance around electrical boxes and similar items.

D. Do not use chipped, cracked or broken units.

E. Set units plumb, true to line, and level.

F. Adjust units to final position while mortar is soft and plastic. If unit is displaced after mortar has stiffened, remove unit, clean joints and unit of mortar and reset with fresh mortar.

G. When joining fresh work to set or partially set masonry clean exposed surface and remove loose mortar before laying fresh masonry.

H. When necessary to stop a horizontal, run rack back one-half block length in each course, do not tooth.

I. Unless indicated otherwise partitions shall extend from floor to bottom of floor or roof construction above.

J. Where rated partitions run perpendicular to deck, fill voids at deck with grout.

3.4 BOND

A. Lay units in running bond with vertical joints centered on unit in course below unless indicated otherwise on drawings.

3.5 MORTAR BEDS

A. Lay hollow units with full mortar coverage on horizontal and vertical face shells. Provide full mortar coverage on horizontal and vertical face shells and webs where adjacent to cells or cavities to be filled with grout and on starting courses.

B. Lay block with full horizontal and vertical joints.

3.6 WIRE REINFORCEMENT

A. Wire Reinforcements shall be placed as follows:
   1. Four inch concrete block walls with ends adjoining other partitions.
      a. Concrete block on slab on grade - continuous horizontal reinforcements 24 inches on center vertically (every third course).
      b. Concrete block on slabs above grade - Continuous horizontal reinforcement 16 inches on center vertically (every other course).
   2. Eight inch concrete block walls
      a. Concrete block walls on slab on grade - continuous horizontal reinforcement 16 inches on center vertically (every other course).
      b. Concrete block walls on slabs above grade - continuous horizontal reinforcements 24 inches on center vertically (every third course).
   3. Wire reinforcement shall be completely embedded in mortar or grout. Joints with wire reinforcement shall be at least the thickness of the wire.
   4. Wire reinforcement shall be lapped at least 8 inches at splices and shall contain at least one cross wire of each piece of reinforcement in the lapped distance.

3.7 JOINTS

A. Nominal thickness shall be 3/8 inch (9 mm) and uniform.

B. Shove vertical joints tight.

C. Strike joints flush in surfaces to be exposed or painted.

D. Tool joints slightly concave in surfaces to be exposed or painted.

3.8 BUILT-UP WORK

A. Cooperate with other trades in building in items in masonry work.

B. Grout solid around built-in items and in door frames.

3.9 LINTELS

A. Install rebars and grout solid as indicated. Provide temporary shoring for openings wider than 36 inches.

B. Lintel blocks shall extend into side walls at jambs, minimum at 8 inches.

3.10 CLEANING AND POINTING

A. Dry brush masonry surfaces after mortar has set, at end of each day's work and after final points.

B. Cut out and repaint defective joints.

C. At final completion of masonry work fill holes in joints and tool to match adjacent work.

D. Leave work and surrounding surfaces clean and free of mortar spots and droppings.

END OF SECTION

SECTION 051200

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 REFERENCES

A. American Institute of Steel Construction (AISC):

1. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
2. AISC - Code of Standard Practice - Manual of Steel Construction - Allowable Stress Design (ASD).

B. American Society for Testing and Materials (ASTM):

1. ASTM A36/A36M - Specification for Structural Steel.
2. ASTM A53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A108 - Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
4. ASTM A123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153 - Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
6. ASTM A242/A242M - Specification for High-Strength Low-Alloy Structural Steel.
7. ASTM A 307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
8. ASTM A 325 - Specification for Structural Bolts, Heat Treated, 120/105 ksi Minimum Tensile Strength.
9. ASTM A449 - Specification for Quenched and Tempered Steel Bolts and Studs.
10. ASTM A490 - Specification for Heat-Treated Steel Structural 150 ksi Minimum Tensile Strength.
11. ASTM A 500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
12. ASTM A 501 - Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
13. ASTM A514/A514M - Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
14. ASTM A529/A529M - Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
15. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.
16. ASTM A992/A992M: Standard Specification for Structural Steel Shapes.

C. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code.

D. Steel Structures Painting Council (SSPC):

1. SSPC - Painting Manual.
2. SSPC-Paint 20 Type II - Zinc Rich Primers - Organic.
3. SSPC-Paint 22 - Epoxy Polyamide Paints.
4. SSPC-Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.
5. SSPC-SP 2 - Hand Tool Cleaning.
6. SSPC-SP 6 - Commercial Blast Cleaning.

1.2 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.

1. Shop Drawings:

a. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
b. Connections.
c. Cambers and loads.
d. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths.

2. Assurance/Control Submittals:

a. Erection Procedure: Submit descriptive data to illustrate structural erection procedure including sequence of erection and temporary staying and bracing.
b. Field Welding Equipment: Submit descriptive data for field welding equipment including type, voltage, and amperage.
c. Test Reports: Submit the following reports directly to Contracting Officer from Testing Laboratory, with copy to Contractor. Prepare reports in conformance with Section 014000 - Quality Requirements:
1) Welding inspection.
2) Bolted connection inspection.
d. Certificates: Certify welders employed on Work, verifying AWS qualification within previous 12 months.
e. Qualification Documentation: Submit documentation of fabricator and erector experience indicating compliance with specified qualification requirements.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Fabricator: Company specializing in performing the work of this section with minimum 5 years documented experience.
2. Erector:

a. A company specialized in performing the work of this section with a minimum of 5 years documented experience.
3. Qualifications for Welding Work: Qualify welding operators in accordance with AWS Standard Qualification Procedures. Provide certification that welders employed in work have satisfactorily passed AWS qualification tests within previous 12 months. If rectification of welders is required, provide without additional cost to Owner.

B. Fabricate structural steel members in accordance with AISC Code of Standard Practice.

C. Perform Work in accordance with AISC Section 10.

D. Design connections not detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in State where Project is located.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Store steel above ground on platforms, skids, or other supports.

C. Protect steel from corrosion.

D. Store packaged materials in their original, unbroken packages or containers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes, Plates and Bars: ASTM A 36.

B. Structural Tubing: ASTM A 500, Grade B.

C. Bolts, Nuts, and Washers: AISC Specification Section 1.4.4.

1. Unfinished Bolts: ASTM A 307.
2. High Strength Bolts: ASTM A 325 or A 490.
3. Anchor Bolts and Nuts: ASTM A 307 Grade A.
4. High Strength Anchor Bolts: ASTM A 490.

D. Welding Materials: AWS D1.1; type required for materials being welded or as indicated on Drawings.

E. Shop and Touch-Up Primer: AISC Specification Section 1-24.

2.2 FABRICATION

A. Fabricate structural steel members in accordance with AISC Code Section 6 and AISC Specification.

B. Connections not detailed on Drawings: Engineer by fabricator, which is subject to review.

C. Fabricator's Responsibility:

1. Errors of detailing, fabrications, and for correct fitting of structural steel members.
2. Do not splice structural steel members. Members having splice not indicated on Drawings will be rejected.

D. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

E. Fabricate connections for bolt, nut, and washer connectors.

F. Develop required camber for members.

2.3 FINISH

A. Clean, prepare, and shop prime structural steel members in accordance with SSPC - Painting Manual. Do not paint surfaces in contact with concrete, or surfaces specified to be galvanized.

B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, and high strength bolted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 PREPARATION

A. Supply items required to be cast into concrete or embedded in masonry with setting diagrams to appropriate Sections.

3.3 ERECTION

A. Erect structural steel in accordance with AISC Code, Section 7, and AISC Specification Section 1.25 except as specified herein.

B. Make provision for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Do not field cut or alter structural members without approval of Contracting Officer.

D. Field weld components indicated on Drawings.

E. Field connect members with threaded fasteners; torque to required resistance.

F. After erection, prime welds, abrasions, and surfaces not shop painted that are to receive finish painting, except surfaces to be in contact with concrete. Use a primer consistent with shop coat.

G. Anchor Bolts: Install anchor bolts and other connectors required for securing structural steel to foundations and other in-place work. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

H. High-strength Bolting: Comply with specifications for Structural Joints using ASTM A 325 or A 490 Bolts.

I. Erection Bolts:

1. Comply with ASTM A 307.
2. On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

J. Touch-up Painting: Immediately after erection, clean exposed field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

3.4 CONSTRUCTION

A. Site Tolerances:

1. Maximum Variation From Plumb: 1/4 inch.
2. Maximum Offset From True Alignment: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field testing and inspection.

B. Quality Assurance Program:

1. AISC Code Section 8 and AISC Specification Section 1.26.
2. AISC Quality Criteria and Inspection Standards, except as specified herein.

C. Welding:

1. AWS D1.1 Section 6.
2. Inspectors: AWS Certified in accordance with AWS QCI, Standard for Qualifications and Certification of Welding Inspectors.

END OF SECTION

SECTION 061000

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 REFERENCES

A. American Lumber Standards Committee (ALSC):

1. Softwood Lumber Standards.

B. American Society for Testing and Materials (ASTM):

1. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
2. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

PART 2 - PRODUCTS

2.1 LUMBER MATERIALS

A. Lumber, finished 4 sides, 15 percent maximum moisture content. Each piece of lumber to be factory marked with type, grade, mill and grading agency.

1. Structural framing and timbers: No. 1 grade Douglas Fir, Southern Pine, or Spruce, appearance grade where exposed.

2.2 NAILERS, BLOCKING, FURRING AND SLEEPERS

A. Wood for nailers, blocking, furring and sleepers: Construction grade, finished 4 sides, 15 percent maximum moisture content.

2.3 FASTENERS

A. Fasteners: Provide manufacturers recommended power tools for each type of fastener.

1. Bolts, Nuts, Washers, Lag Screws, and Wood Screws: ASTM A307, Medium carbon steel; size and type to suit application; galvanized for treated wood; plain finish for other interior locations, of size and type to suit application, unless otherwise noted.

B. METAL FRAMING ANCHORS

1. Allowable design loads, as published by manufacturer, shall meet or exceed 500 pounds. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
2. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, coating designation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

1. Verify that spacing, direction and details of supports are correct to accommodate installation of blocking, backing, stripping, furring and nailing strips.

B. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION - FRAMING

A. Set structural members level and plumb, in correct position.

B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Place horizontal members, crown side up.

D. Construct load bearing framing and curb members full length without splices.

E. Double members at openings as indicated on Drawings. Space short studs over and under opening to stud spacing.

F. Secure in place with appropriate fasteners. Use fasteners of correct size that will not penetrate members where opposite side will be exposed to view or require finishing. Do not split wood with fasteners; set panel products to allow expansion at joints.

G. Construct members of continuous pieces of longest possible lengths.

3.3 CONSTRUCTION

A. Site Tolerances:

1. Framing Members: 1/4 inch from true position, maximum.

END OF SECTION

SECTION 078400

FIRESTOPPING

PART 1 - GENERAL

1.1 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E 119 - Test Methods for Fire Tests of Building Construction and Materials.
   2. ASTM E 814 - Test Methods for Fire Tests of Through Penetration Fire Stops.

B. Underwriters' Laboratories, Inc. (UL):
   1. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.2 DEFINITIONS

A. Firestopping: Sealing material or assembly placed in spaces between building materials to stop movement of smoke, heat, gasses, or fire through wall openings.

1.3 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E 119, ASTM E 814, UL 1479 to achieve a fire rating as indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this Section with minimum 5 years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver Products in manufacturer's original unopened containers or packages with labels intact, identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions, where applicable.

B. Store and handle materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements:
   1. Do not install materials when temperature of substrate material and ambient air is below 60 degrees F.
   2. Maintain minimum temperature before, during, and for 3 days after installation of materials.
   3. Keep away from heat, open flame, sparks, or other sources of ignition until curing is complete. Use only with adequate ventilation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturer's offering firestopping materials which may be incorporated in the work include the following:
   1. Nelson Firestop Products, Tulsa, OK (800) 331-7325.
   2. Hilti Firestop Systems, Tulsa, OK (800) 879-8000.
   3. The Rectorseal Corporation, Houston, TX (800) 231-3345.
   4. Specified Technologies, Incorporated (STI), Somerville, NJ (800) 992-1180.
   5. 3M Fire Protection Products, St. Paul, MN (800) 328-1687.
   6. Tremco Firestop System, Beechwood, OH (800) 321-7906.

B. Other products such as USG Firestop System by U.S. Gypsum Co. are acceptable if complying with requirements.

C. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.2 MATERIALS

A. Intumescent Latex Sealant: Single-component, intumescent, latex formulation.
   1. LBS, by Nelson Firestop Products.
   2. Metacaulk 950 or 1000, by RectorSeal.
   3. SpecSeal SSS100, by STI.
   4. CP 25WB+, by 3M.
   5. TREMstop WBM, by Tremco.

B. Intumescent Solvent-Release-Curing Sealant: Single component, intumescent, synthetic-polymer based, non-sag grade.
   1. CP 25N/S, by 3M.
   2. TREMstop WBM, by Tremco.

C. Intumescent Wrap/Strip: Single-component, elastomeric sheet with aluminum foil on one face.
   1. WRS, by Nelson Firestop Products.
   2. Metacaulk Wrap Strip, by RectorSeal.
   3. SpecSeal SSWRED Wrapstrip, by STI.
   4. FS-195+ Wrap/Strip, by 3M.
   5. TREMstop WS, by Tremco.

D. Intumescent Putty: Single-component, non-hardening, dielectric, intumescent putty.
   1. FSP, by Nelson Firestop Products.
   2. Metacaulk Fire Rated Putty, by RectorSeal.
   3. SpecSeal Putty, by STI.
   4. Moldable Putty+, by 3M.

E. Silicone Sealant: Single-component, moisture-curing, silicone-based elastomeric, non-sag grade.
   1. CLK N/S, by Nelson Firestop Products.
   2. FS 601, by Hilti.
   3. Metacaulk 835+, by RectorSeal.
   4. SpecSeal PEN 300, by STI.
   5. 2000+ Silicone, by 3M.
   6. FYRE SIL, by Tremco.

F. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.
   1. FS Fireblocks, by Hilti.
   2. SpecSeal PEN 200, by STI.
   3. 2001 Silicone RTV Foam, by 3M.

G. Intumescent Collar: Factory-fabricated, intumescent collar.
   1. PCS, by Nelson Firestop Products.
   2. CP 642, by Hilti.
   3. Metacaulk Pipe Collar, by RectorSeal.
   4. SpecSeal SSC Collars, by STI.
   5. Plastic Pipe Device, by 3M.
   6. TREMstop D, by Tremco.

H. Intumescent Composite Sheet or Pillows and Mortar: Intumescent sheet used to firestop large openings.
   1. CPS, by Nelson Firestop Products.
   2. SpecSeal SSB Pillows and SpecSeal SSM Firestop Compound, by STI.
   3. CS-195+ Composite Sheet, by 3M.
   4. TREMstop PS, by Tremco.

I. Packing Material: Manufacturer's standard mastic, putty, ceramic fiber blanket, or mineral wool to be used as fill or backing material for firestopping.
   1. FSB or Mineral Wool, by Nelson Firestop Products.
   2. Mineral Wool, by Hilti.
   3. Fire Safing or Backer Rod, by RectorSeal.
   4. Mineral Wool Safing, by STI.
   5. FireMaster Mastic, FireMaster Putty, or FireMaster Bulk, by 3M.
   6. Cerablanket, by Tremco.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to United States Postal Service.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.

B. Remove incompatible materials which may affect bond.

C. Place hangers or damming materials in penetration to hold firestopping materials where required.

3.3 INSTALLATION

A. Follow manufacturer charts for appropriate material to achieve required fire rating in various locations.

B. Install firestopping at penetrations of fire rated wall materials by sleeves, piping, ductwork, conduit, and other items in accordance with manufacturer's published instructions.

3.4 CLEANING AND PROTECTION

A. Clean excessive fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturer's of firestopping Products and of products in which opening and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations.

C. If damage occurs, cut out and remove damaged or deteriorated firestopping and install new materials.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Inspection procedures.

B. Contracting Officer will inspect each firestopping installation. Do not cover firestopping installations that will be concealed by other construction until Contracting Officer inspection.

3.6 SCHEDULES

A. Provide firestopping complying with UL assemblies specified below.

Penetration	Assembly	Nelson	Hilti	RectorSeal	STI	3M	Tremco
Metal Pipe	CMU Wall 8" Thick or Less	CAJ1224 or CAJ1203	CAJ1150 or CAJ1158	CAJ1114 or CAJ1115	CAJ1079 or CAJ1217	CAJ1001 or CAJ1009	CAJ1179 or CAJ1187
	Gypsum Board Partition	WL1083 or WL1030	WL1052 or WL1054	WL1026 or WL1034	WL1049 or WL1079	WL1003 or WL1009	WL1020 or WL1051
Non-Metallic Pipe	CMU Wall 8" Thick or Less	CAJ2086	CAJ2095 or CAJ2109	CAJ2021 or WJ2025	CAJ2064 or CAJ2045	CAJ2005	CAJ2082 or FA2024
	Gypsum Board Partition	WL2071	WL2078	WL2015 or WL2104	WL2093 or WL2029	WL2002 or WL2005	WL2083 or WL2082
Cable Tray	CMU Wall 8" Thick or Less	CAJ8049 or CAJ4033	CAJ4017	CAJ8043	CAJ4020 or CAJ4029	CAJ4003 or CBJ4020	CAJ4007 or WJA4005
	Gypsum Board Partition	WL4003	WL4006	N/A	WL4005 or WL4008	WL4004	WL3043 or WL3044
Insulated Metal Pipe	CMU Wall 8" thick or Less	CAJ5008 or CAJ5059	CAJ5045	WJ5016 or CAJ5070	CAJ5021 or CAJ5029	CAJ5001 or CAJ5002	CAJ5052 or CBT5005
	Gypsum Board Partition	WL5036	WL5022 or WL5029	WL5057	WL5014 or WL5051	WL5001	WL5034
Construction Gaps	CMU Wall to Metal Deck	N/A	HW-D-0008	TRC/PV120-14	U900Z020	U900Z028	U900Z013 or U900Z014
	Gypsum Board Partition to Metal Deck	N/A	HW-D-0003 or HW-D-0004	HWD0014 or TRC/PV120-14	HWD1001	U400V	WHPV60.01 or U900Z014

END OF SECTION

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM C717 - Standard Terminology of Building Seals and Sealants.
   2. ASTM C834 - Specification for Latex Sealants.
   3. ASTM C920 - Specification for Elastomeric Joint Sealants.
   4. ASTM D1056 - Flexible Cellular Material- Sponge or Expanded Rubber.

B. Federal Specifications (FS):
   1. FS SS-S-200 - Sealing Compounds, Two Component, Elastomeric, Polymer Type, Jet-Fuel Resistant, Cold Applied.
   2. FS TT-S-1657 - Sealing Compound, Single Component Butyl Rubber Based Solvent Release Type (for Buildings and other Types of Construction).

1.2 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing Work of this Section with minimum 5 years documented experience.

1.3 DELIVERY, STORAGE AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect products.

B. Deliver Products in manufacturer's original unopened containers or packages with labels intact, identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions, where applicable.

C. Store and handle materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.4 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements: Install sealant during manufacturer's recommended temperature ranges and weather conditions for application and cure. Consult manufacturer when sealant cannot be applied during recommended conditions.

1.5 WARRANTY

A. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.

B. Warranty:
   1. Submit written warranty signed by sealant manufacturer agreeing to replace sealants and accessories which fail because of loss of cohesion or adhesion or which do not cure.
   2. Warranty Period: 5 years or longer per the manufacturers’ standard warranties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated into the work include the following:
   1. Bostik, Inc, Huntingdon Valley, PA, (800) 523-2678, (125) 674-5600.
   2. Dow Corning, Midland, MI (517) 496-4000.
   3. GE Silicones, Waterford, NY (518) 233-3330.
   4. Mameco International, Cleveland, OH, (800) 321-6412, (216) 752-4400.
   5. W.R. Meadows, Inc, Elgin, IL (800) 342-5976, (847) 683-4500.
   6. Nomaco, Inc., Zebulon, NC, (919) 269-6500.
   7. Pecora Corporation, Harleysville, PA, (800) 523-6688, (215) 723-6051.
   8. Sika Corporation, Lyndhurst, NJ, (800) 933-7452, (201) 933-8800.
   9. Sonneborn Building Products Div. ChemRex, Inc., Shakopee, MN (800) 243-6739, (612) 496-6000.
   10. Tremco, Beachwood, OH, (800) 852-3821, (216) 292-5000.
   11. USG Corp., Chicago, IL (800) 874-4968, (312) 606-4000.
   12. Sherwin-Williams Co. (The), Cleveland, OH (800) 321-8194

2.2 BUILDING SEALANTS (See Sealant Schedule at the end of this Section for specific use of sealants.)

A. Urethanes:
   1. Type 1: Two-Part Urethane: Self-Leveling, ASTM C920, Type M, Grade P, Class 25.
      a. Chem-Calk CC-550, by Bostik.
      b. Vulkem 245, by Mameco.
      c. Vulkem 255, Wide-Joint, by Mameco.
      d. NR-200 Urexpan, by Pecora Corporation.
      e. Loxon 2K SL Multi-Comppnent Polyurethane Sealant, by Sherwin-Williams.
   2. Type 2: Two-Part Urethane: Non-Sag, ASTM C920, Type M, Grade NS, Class 25.
      a. Chem-Calk 500, by Bostik.
      b. Vulkem 227, by Mameco.
      c. Sonolastic NP 2, by Sonneborn Building Products, ChemRex Inc.
      d. Loxon 2K NS Multi-Component Polyurethane Sealant, by Sherwin-Williams.
   3. Type 3: One-Part Urethane: Self-Leveling, ASTM C920, Type S, Grade P, Class 25.
      a. Vulkem 45, by Mameco.
      b. Urexpan NR-201, by Pecora Corporation.
      c. Sonolastic SL1, by Sonneborn Building Products, ChemRex Inc.
      d. Sikaflex 1C-SL by Sika.
      e. Loxon 1K SL Polyurethane Sealant, by Sherwin-Williams.
   4. Type 4: One-Part Urethane: Non-Sag, ASTM C920, Type S, Grade NS, Class 25.
      a. Chem-Calk 900, by Bostik.
      b. Vulkem 116, by Mameco.
      c. Sonolastic NP I, by Sonneborn Building Products, ChemRex Inc.
      d. Loxon 1K Smooth Polyurethane Sealant, by Sherwin-Williams.

B. Silicones:
   1. Type 1: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 50.
      a. 795 Silicone Building Sealant, by Dow Corning.
      b. 864 Architectural Silicone Sealant, by Pecora Corporation.
      c. White Lightning Silicone Ultra Sealant, by Sherwin-Williams.
   2. Type 2: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 25.
      a. 999-A Silicone Building & Glazing Sealant, Dow Corning.
      b. Construction 1200 Sealant, General Electric Company.

3. Type 3: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 25. Vertical Surfaces Only.
   a. Construction 1200 Sealant, General Electric Company.
   b. 999-A, Dow Corning.
   c. 860 Glaziers and Contractors Silicone Sealant, by Pecora Corporation. (colors only)
4. Type 4: One-Part Silicones: ASTM C920, Type S, Grade NS, Class 25 or 50.
   a. 786 Mildew Resistant Silicone Sealant, Dow Corning.
   b. SCS 1700 Sanitary Sealant, General Electric.
   c. 898 Silicone Sanitary Sealant, Pecora Corporation.

C. Acrylics, Latex:
1. Type 1: One-Part Acrylic Latex, Non-Sag, ASTM-C-834-76.
   a. Chem-Calk 600, by Bostik.
   b. LC-130, by MACCO Adhesives, The Glidden Company.
   c. Easa-ply ALS, by W. R. Meadows, Inc.
   d. AC-20+Silicone Acrylic Latex, by Pecora Corporation.
   e. Sonolac, Sonneborn Building Products, ChemRex Inc
   f. 950A Siliconized Acrylic Latex Caulk, by Sherwin-Williams.

D. Butyls:
1. Type 1: One-Part Butyl, Non-Sag, FS TT-S-1657.
   a. Chem-Calk 300, by Bostik.
   b. BC-158 Butyl Rubber, by Pecora Corporation. (ASTM C1085)
   c. White Lightning Butyl Rubber Caulk, by Sherwin-Williams. (ASTM C1311)

E. Preformed Compressible & Non-Compressible Fillers:
1. Type 1: Backer Rod - Closed cell polyethylene foam:
   a. HBR Backer Rod, by Nomaco.
   b. #92 Greenrod, by Nomaco.
   c. Sonofoam Closed-Cell Backer Rod, Sonneborn Building Products, ChemRex Inc.
2. Type 2: Backer Rod - Open cell polyurethane foam:
   a. Denver Foam, by Backer Rod Mfg Inc.
   b. Foam Pack II, by Nomaco.
3. Type 3: Neoprene compression seals:
   a. WE, WF, and WG Series, by Watson Bowman & Acme Corp.
   b. Will-Seal 150 Precompressed Expanding Foam Sealants, by Will-Seal, a Division of Illbruck.
4. Type 4: Butyl Rod: Kirkhill Rubber Co. (714)529-4901.

F. Bond Breaker Tape: Polyethylene tape of plastic as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate of joint filler must be avoided for proper performance of sealant

2.3 COLORS

A. Generally, use sealant colors matching color of material joint is located in.

B. Where a joint occurs between two materials of differing colors and Contractor cannot determine which material to match, contact Contracting Officer for selection.

2.4 ACCESSORIES

A. Joint Cleaner: Provide type of joint cleaning compound recommended by sealant manufacturer for joint surfaces to be cleaned.

B. Primer: As recommended by sealant manufacturer.

C. Masking tape and similar accessories to protect surfaces from damage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify that joint widths are in conformance with sealant manufacturer allowable limits.
   2. Verify that contaminants capable of interfering with adhesion have been cleaned form joint and joint properly prepared.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 PREPARATION

A. Prepare and size joints in accordance with manufacturer's instructions. Clean substrates of dirt, laitance, dust, or mortar using solvent, abrasion, or sandblasting as recommended by manufacturer. Remove loose materials and foreign matter which might impair adhesion of sealant.

B. Verify that joint backing and release tapes are compatible with sealant. Verify sealant is suitable for substrate. Verify that sealant is paintable if painted finish is indicated.

C. Protect materials surrounding work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Install sealant in accordance with manufacturer's published instructions.

B. Prime or seal joint surfaces where recommended by sealant manufacturer. Do not allow primer or sealer to spill or migrate onto adjoining surfaces.

C. Install backer rod and bond breaker tape where required by manufacturer.

D. Install preformed compressible and non-compressible fillers in accordance with manufacturer's published instructions.

E. Install sealants to depths recommended by sealant manufacturer in uniform, continuous ribbons free of air pockets, foreign embedded matter, ridges, and sags, "wetting" joint bond surfaces equally on both sides.

F. Tool joints concave unless shown otherwise. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form slight cove so that joint will not trap moisture and foreign matter. Dry tool joints. Do not use soap, water, or solvent to tool joints.

G. Epoxy Floor Joint Sealant: Install sealant at floor construction and control joints in accordance with manufacturer's published instructions and initially under manufacturer's supervision.

3.4 CURING

A. Cure sealants in compliance with manufacturer's published instructions.

3.5 CLEANING

A. Remove excess and spillage of sealants promptly as the work progresses, using materials and methods as recommended by sealant and substrate manufacturers. Clean adjoining surfaces to eliminate evidence of spillage without damage to adjoining surfaces or finishes.

3.6 SEALANT SCHEDULE

A. Exterior Joints:
   1. Perimeters of exterior openings where frames and other penetrations meet exterior facade of building: precast concrete, brick, CMU, polymer reinforced concrete.
      a. Sealant Urethane Type 2
      b. Sealant Silicone Type 1 (for prefinished materials only)
   2. Exterior joints in horizontal wearing and non-wearing surfaces.
      a. Sealant No. Urethane Type 1
      b. Sealant No. Urethane Type 3
      c. Preformed Compressible & Non-Compressible Filler Type 1
   3. Painted metal lap or flashing joints.
      a. Sealant Silicone Type 1

B. Interior Joints:
   1. Seal interior perimeters of exterior openings.
   2. Interior masonry vertical control joints and intersecting masonry walls; CMU-to-CMU, CMU-to-concrete.
   3. For all of the above interior joints:
      a. Sealant Urethane Type 2
      b. Sealant Urethane Type 4
      c. Sealant Silicone Type 1 (for prefinished materials only)
   4. Joints of underside of precast beams or planks.
      a. Sealant Urethane Type 2
      b. Sealant Urethane Type 4
   5. Painted metal lap joints.
      a. Sealant Silicone Type 1

END OF SECTION

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Basic mechanical methods.
2. Supports and anchors.
3. Motors.
4. Mechanical identification.
5. Vibration isolation.
6. Sleeves and seals.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

C. Related Sections:
1. 078400 - Firestopping: Materials for closure of penetrations at rated assemblies.
2. 079200 - Joint Sealants: Sealants.
3. 099100 - Painting: Field painting.
4. 230915 – Variable Frequency Motor Controllers
5. 019113 General Commissioning Requirements: Requirements related to Division 23 Commissioning

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

B. American Society of Mechanical Engineers (ASME):
1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. ASME B31.5 - Refrigeration Piping
3. ASME B31.9 - Building Services Piping

C. National Fire Protection Association
1. NFPA 13 - Installation of Sprinkler Systems.

D. Institute of Electrical and Electronic Engineers
1. IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

E. National Electrical Manufacturers Association
1. NEMA MG 1 - Motors and Generators.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
1. Product Data:
a. Motors: Provide wiring diagrams with electrical characteristics and connection requirements.
b. Mechanical Identification: Provide manufacturers catalog literature for each product required.

B. Section 017704 – Closeout Procedures and Training: Procedures for closeout submittals.
   1. Project Record Documents: Accurately record the following:
      a. Record actual locations of tagged valves; include valve tag numbers.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Conform to applicable local code for support of plumbing piping.
   2. Supports for Fire Suppression Piping: In conformance with NFPA 13.
   3. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.

1.6 BASIC MECHANICAL METHODS

A. Comply with manufacturer's published instructions for delivery, storage, protection, installation, and materials.

B. When equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install new filter media, make all required adjustments, and complete all punch list items before final acceptance by the Construction Manager and Contracting Officer.

C. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

D. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

E. Items exposed (in areas without ceilings) shall be installed in a neat, orderly manner. Elements shall be perpendicular and parallel to building lines.

F. In those conditions where ductwork is exposed in finished areas, careful craftsmanship and only the highest standards of installation will be acceptable. All routing of exposed ducts, pipes, conduits, shall be approved in advance by the Contracting Officer prior to installation.

G. Drawings And Specifications:
   1. The Drawings indicate the general arrangement of systems and are to be followed insofar as possible. If deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted in writing to the Contracting Officer, for approval before proceeding with the work.
   2. This Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. Contractor shall coordinate this work with all other branches in such a manner as to cause a minimum of conflict or delay.

3. Where any work is so placed as to cause or contribute to a conflict it shall be readjusted at the expense of the Contractor causing the conflict. The decision shall be final in regard to the arrangement of ducts, piping, etc., where conflict arises.
4. Where offsets in systems are required to complete the installation, or for the proper operation of the system, these shall be deemed to be included in the Contract.
5. Significant deviations from the Drawings must be approved by the Contracting Officer's Representative (COR).

H. Locations:
1. Mechanical layouts indicated on drawings are diagrammatic. Exact locations of ducts, pipes, and equipment may vary because of conflicts with work of other trades. Work out conflicts where relocations will not affect operation or appearance of systems.
2. Locate equipment requiring periodic servicing so that it is readily accessible. Do not back up service sides to walls, nor place it too close to other equipment to make service impractical.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
1. Grinnell, Exeter, NH (603) 778-9200.
2. Other acceptable manufacturers offering equivalent products.
   a. Elcen
   b. Fee and Mason
   c. Kin-Line
   d. Michigan
   e. Unistrut
3. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Refrigerant Piping:
1. Conform to ASME B31.5.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. See Hanger and Support schedule at end of this Section.

2.2 MOTORS

A. Electric motors shall be new NEMA Standard, sized and designed to operate at full load and full speed continuously, or variable frequency drive duty as required, without causing noise, vibration, and temperature rise in excess of their rating.

B. Motors on belt driven equipment shall have slide rails with adjusting screws for belt tension adjustment. Motors exposed to the weather shall be weather-protected.

C. Premium efficiency electric motors shall be installed on air handling units, relief fans, and exhaust fans.

D. Premium efficiency motors shall have efficiency and losses determined in accordance with the latest revisions of IEEE Standard 112. Polyphase squirrel-cage motors rated 1 through 125 horsepower shall be tested by dynamometer method B. The efficiency will be determined using segregated losses in which stray load loss is obtained from a linear regression analysis to reduce the effect of random errors in the test measurements. Guaranteed minimum load efficiency shall be as follows:

MOTOR HP	FULL LOAD RPM	GUARANTEED FULL LOAD EFF.
1	1800	85.5
1.5	1800	86.5
2	1800	86.5
3	1800	89.5
5	1800	89.5
7-1/2	1800	91.7

E. Motor sound power levels shall not be greater than recommended in NEMA MG 1-12.49.

F. Provide motors with drive shafts long enough to extend completely through belt sheaves when sheaves are properly aligned or balanced.

G. Motor Characteristics:
1. 120V/1/60 Hz: Capacitor start, open drip-proof type, ball bearing, rated 40 C. continuous rise.

H. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
1. GE
2. Other acceptable manufacturers offering equivalent products.
   a. Lincoln
   b. Reliance
   c. Louis Alis
3. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

I. Motor Sentinel Switches:
1. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   a. Square D Class 2510
   b. Siemens SCN or SCF Series.
   c. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

J. Combination Starter/Disconnect:
1. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   a. Square D Class 8538 or 8539
   b. Siemens SCN or SCF Series.
   c. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

K. Motor/Circuit Disconnects:

1. Manufacturers: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   a. Square D Class Type HU.
   b. Siement/I-T-E Enclosed Switch.
   c. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.3 MECHANICAL IDENTIFICATION

A. Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.

B. Tags
1. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches (38 mm) square.
2. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inches (38 mm) diameter with smooth edges.
3. Information Tags: Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches (83 x 143 mm) with grommet and self-locking nylon ties.
4. Tag Chart: Typewritten letter size list in anodized aluminum frame or plastic laminated.

C. Pipe Markers
1. Color and Lettering: Conform to ASME A13.1.
2. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
3. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
4. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

2.4 VIBRATION ISOLATION

A. Type 1: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

B. Type 2: Open spring mount with stiff springs (horizontal stiffness equal to vertical stiffness).

C. Type 3: Open spring mount with stiff springs, heavy mounting frame, and limit stop.

D. Type 4: Closed spring mount with stiff springs and limit stop.

E. Type 5: Closed spring hanger with acoustic washer.

F. Type 6: Closed spring hanger with one inch (25 mm) thick acoustic isolator.

G. Type 7: Elastomer mount with threaded insert and hold down holes.

H. Type 8: Neoprene jacketed pre-compressed molded glass fiber.

I. Type 9: Rubber waffle pads, 30 durometer, minimum 1/2 inch (13 mm) thick, maximum loading 40 psi (275 kPa). Use neoprene in oily or exterior locations.

J. Type 10: 1/2 inch (13 mm) thick rubber waffle pads bonded each side of 1/4 inch (6 mm) thick steel plate.

2.5 SLEEVES AND SEALS

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm thick) galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage (1.2 mm thick) galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 078400.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

F. Firestopping Insulation: Glass fiber type, non-combustible; refer to Section 078400.

G. Sealant: refer to Section 079200.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 PREPARATION - MECHANICAL IDENTIFICATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.3 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.
B. The use of lead-containing solder for plumbing and plumbing fixtures is prohibited in the construction of this project.

3.4 INSTALLATION - PIPE HANGER AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

C. Place hangers within 12 inches (300 mm) of each horizontal elbow.

D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide copper plated hangers and supports for copper piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.5 INSTALLATION - MOTORS

A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

B. Line up motors on direct drive dial type gauges.

C. Check line voltage and phase and ensure agreement with nameplate.

D. Make electrical connections and test motor for proper rotation/ phasing under Division 26.

E. Adjust motors together with driven equipment to insure equipment is dynamically and statically balanced. Correct any excessive vibration or noise from the equipment.

3.6 INSTALLATION - MECHANICAL IDENTIFICATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install tags using corrosion resistant chain. Number tags consecutively by location.

D. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

E. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

F. Identify control panels and major control components outside panels with plastic nameplates.

G. Identify valves in main and branch piping with tags.

H. Identify air terminal units and radiator valves with numbered tags.

I. Tag automatic controls, instruments, and relays. Key to control schematic.

J. Identify piping, concealed or exposed, with plastic pipe markers and plastic tape pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

L. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.7 INSTALLATION - VIBRATION ISOLATION

A. Install vibration isolators for motor driven equipment.

B. Set steel bases for one inch (25 mm) clearance between housekeeping pad and base. Set concrete inertia bases for 2 inch (50 mm) clearance. Adjust equipment level.

C. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inch (100 mm) diameter, first three points of support; 5 to 8 inch (125 to 200 mm) diameter, first four points of support; 10 inch (250 mm) diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.

3.8 PIPE HANGER AND SUPPORT SCHEDULE

PIPE SIZE Inches (mm)	MAX. HANGER SPACING Feet (m)	HANGER ROD DIAMETER Inches (mm)
1/2 to 1-1/4 (12 to 32)	6.5 (2)	3/8 (9)
1-1/2 to 2 (38 to 50)	10 (3)	3/8 (9)
2-1/2 to 3 (62 to 75)	10 (3)	1/2 (13)

END OF SECTION

SECTION 230523

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Ball valves.
   2. Gate valves.
   3. Globe Valves.
   4. Butterfly valves.

1.2 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves except domestic hot- and cold-water piping.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Valves: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   1. American Valve, Inc.
   2. Bray International, Inc.
   3. Crane Co.; Crane Valve Group;
   4. Grinnell Corporation.
   5. Hammond Valve.
   6. Metraflex Co.
   7. Milwaukee Valve Company.
   8. NIBCO INC.
   9. Red-White Valve Corp.
   10. Tyco International, Ltd.; Tyco Valves & Controls.
   11. Watts Industries, Inc.; Water Products Div.

B. Refer to valve application paragraphs for applications of valves.

C. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.

D. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.

E. Valve Actuators: Handwheel for valves other than quarter-turn types and lever handle for quarter-turn valves.

F. Copper-Alloy Ball Valves, General: MSS SP-110.
   1. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and [600-psig (4140-kPa)] minimum CWP rating and blowout-proof stem. Valve stem shall be stainless steel construction.

G. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
   1. Flangeless, 150-psig (1035-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one- or two-piece stem with aluminum bronze disc. All stem sections shall be stainless steel.
   2. Single-Flange, 150-psig (1035-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem. All stem sections shall be stainless steel.

H. Bronze Check Valves, General: MSS SP-80.
   1. Class 125, Bronze, Swing Check Valves: Bronze body with aluminum bronze disc and seat.

I. Spring-Loaded, Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
   1. Class 125, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.

J. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
   1. Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge .

K. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
   1. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.
   2. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.
   3. Class 250, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.
   4. Class 250, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

L. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.
   1. Class 125, Bronze Globe Valves: Bronze body with bronze disc.

M. Cast-Iron Globe Valves, General: MSS SP-85.
   1. Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS:

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly, or gate valves.
   2. Throttling Service: Ball, butterfly, or globe valves.
   3. Pump Discharge: Spring-loaded, lift-disc check valves.
   4. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

3.2 DOMESTIC WATER PIPING:

A. Use the following types of valves:
   1. Ball Valves: Two-piece, 400-psig (2760-kPa) CWP rating, copper alloy.
   2. Swing Check Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.
   3. Spring-Loaded, Lift-Disc Check Valves, NPS 2 (DN 50) and Smaller: Class 125 minimum.
   4. Gate Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.
   5. Globe Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze.

3.3 SELECT VALVES

A. Valves with the following end connections:
   1. For Copper Tubing: Solder-joint or threaded ends
   2. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
   3. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded ends.
   4. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 VALVE INSTALLATION:

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and swing check valves in horizontal position with hinge pin level.

G. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
   1. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Testing, adjustment, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.
3. Sound measurement of equipment operating conditions.
4. Vibration measurement of equipment operating conditions.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

1.2 REFERENCES

A. Associated Air Balance Council (AABC):
1. AABC - National Standards for Total System Balance.

B. National Environmental Balancing Bureau.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
1. Assurance/Control Submittals:
a. Test Reports: Submit the following reports directly to Contracting Officer from Testing Laboratory, with copy to Contractor. Prepare reports in conformance with Section 014000 - Quality Requirements:
1) Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
2) Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for inclusion in operating and maintenance manuals.
3) Provide reports in binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
4) Indicate data on AABC National Standards for Total System Balance forms.
b. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
c. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
1. Project Record Documents: Accurately record the following:
a. Actual locations of balancing valves and rough setting.
2. Submit written special warranty with forms completed in United States Postal Service name and registered with manufacturer as specified in this Section.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Company specializing in testing, adjusting, and balancing of specified with minimum 5 years documented experience. Company to be certified by one of the following.
      a. AABC Certified Independent Testing and Balancing Agency.
      b. National Environmental Balancing Bureau Certified Independent Agency. (NEBB).

B. Certification: Certify the testing, adjusting, and balancing field data reports.

C. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing Agent's standard forms.

PART 2 - PRODUCTS

(Not Used.)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Contracting Officer to facilitate spot checks during testing.

B. Provide additional balancing instruments as required.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Contracting Officer.

F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities. Perform this work with cooling system energized where applicable to obtain the extra resistance of wet coils.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.

3.6 SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality:
   1. Pre-occupancy ventilation: Provide pre-occupancy ventilation as specified in Section 013543 - Environmental Procedures; provide prior to final testing, adjusting, and balancing of HVAC system.

END OF SECTION

SECTION 230713

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ductwork insulation.
2. Duct liner.
3. Insulation jackets.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
3. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
4. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
5. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
6. ASTM C547 - Mineral Fiber Pipe Insulation.
7. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
8. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
9. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
10. ASTM E84 - Surface Burning Characteristics of Building Materials.
11. ASTM E96 - Water Vapor Transmission of Materials.

B. National Fire Protection Association (NFPA):
1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
1. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

D. Underwriters Laboratories, Inc. (UL):
1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
1. Product Data:
a. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing Products specified with minimum 3 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 3 years documented experience.

B. Materials:
   1. Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255 and UL 723.
   2. Insulation for duct, pipe and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 1 inch thickness less than 53 seconds when tested in accordance with ASTM D1692.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

A. Jobsite Requirements
   1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
   2. Maintain temperature during and after installation for minimum period of 24 hours.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Energy efficiency:
   1. Insulation: Minimum thickness in accordance with ASHRAE 90.1. Provide additional thickness to ensure surface temperatures are below 100 degrees and to prevent condensation on cold surfaces.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION

A. Glass Fiber, Flexible Duct Wrap
   1. Manufacturers:
      a. Owens/Corning, Toledo, OH (800) 438-7465.
      b. Other acceptable manufacturers offering equivalent products.
         1) CertainTeed.
         2) Schuller (Manville).
         3) Knauf.
   2. Insulation: ASTM C553 flexible, noncombustible blanket.

a. 'K' ('Ksi') value : ASTM C518, 0.30 at 75 degrees F.
b. Maximum service temperature: 250 degrees F.
c. Maximum moisture absorption: 0.20 percent by volume.
d. Density: 0.75 lb./cu ft .

3. Vapor Barrier Jacket
   a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   b. Moisture vapor transmission: ASTM E96; 0.02 perm.
   c. Secure with pressure sensitive tape.
4. Vapor Barrier Tape
   a. Manufacturers:
      1) Owens/Corning.
      2) CertainTeed.
      3) Schuller (Manville).
   b. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
5. Tie Wire: Annealed steel, 16 gage.

B. Glass Fiber Duct Liner, Flexible
1. Manufacturers:
   a. CertainTeed.
   b. Other acceptable manufacturers offering equivalent products.
      1) Knauf.
      2) Schuller (Manville).
      3) Owens Corning.
2. Insulation: ASTM C553; flexible, noncombustible blanket.
   a. 'K' ('Ksi') value : ASTM C518, 0.28 at 75 degrees F.
   b. Maximum service temperature: 250 degrees F.
   c. Density: 1.5 lb./cu ft.
   d. Maximum Velocity on Coated Air Side: 4,000 ft./min.
3. Adhesive
   a. Waterproof fire-retardant type.
4. Liner Fasteners: Galvanized steel, impact applied with integral head.

C. Glass Fiber, Rigid Board
1. Manufacturers:
   a. CertainTeed.
   b. Other acceptable manufacturers offering equivalent products.
      1) Knauf.
      2) Schuller (Manville).
      3) Owens Corning.
2. Insulation: Glass fibers bonded with a thermosetting resin for rigidity. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
   a. 'K' ('Ksi') value : ASTM C518, 0.28 at 75 degrees F.
   b. Maximum service temperature: 250 degrees F.
   c. Density: 1.5 lb./cu ft.
3. Vapor Barrier Jacket
   a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   b. Moisture vapor transmission: ASTM E96; 0.02 perm.
   c. Overlap seams with pressure sensitive tape.
4. Vapor Barrier Tape
   a. Manufacturers:
      1) Owens/Corning.
      2) CertainTeed.
      3) Schuller (Manville).
   b. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

5. Pin to ductwork below 8 feet and seal all perforations hardcast mastic.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify that piping has been tested before applying insulation materials.
   2. Verify that ductwork has been tested before applying insulation materials.
   3. Verify that surfaces are clean, foreign material removed, and dry.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION - DUCTWORK INSULATION

A. Install materials in accordance with manufacturer's instructions and ASHRAE 90.1.

B. Insulated ductwork conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. For ductwork exposed in finished spaces below 10 feet above finished floor, finish with aluminum jacket.

E. For exterior applications, provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.

F. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples, tape, or wires.
   3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
3. Seal and smooth joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 CONSTRUCTION

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 DUCTWORK INSULATION SCHEDULE

A. Flexible Glass Fiber Duct Wrap Insulation Schedule:

DUCTWORK	THICKNESS INCH	FINISH
Round Supply Ducts	1-1/2"	Aluminized Film
Round Return Ducts	1-1/2"	Aluminized Film
Round Outdoor Air Intake Ducts	1-1/2"	Aluminized Film

B. Flexible Glass Fiber Duct Liner Insulation Schedule:

DUCTWORK	THICKNESS INCH	FINISH
Plenums (Cooling System)	1"	Black Pigmented, UL
Supply Ducts	1"	Black Pigmented, UL
Return Ducts	1"	Black Pigmented, UL
Outdoor Air Intake Ducts	1"	Black Pigmented, UL
Ducts Exposed to Outdoors	2"	Black Pigmented, UL

END OF SECTION

SECTION 230719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Piping insulation.
   2. Insulation jackets.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   3. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
   4. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   5. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
   6. ASTM C547 - Mineral Fiber Pipe Insulation.
   7. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
   8. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
   9. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
   10. ASTM E84 - Surface Burning Characteristics of Building Materials.
   11. ASTM E96 - Water Vapor Transmission of Materials.

B. National Fire Protection Association (NFPA):
   1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
   1. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

D. Underwriters Laboratories, Inc. (UL):
   1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
   1. Product Data:
      a. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing Products specified with minimum 3 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 3 years documented experience.

B. Materials:
   1. Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255 and UL 723.
   2. Insulation for pipe and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 1 inch thickness less than 53 seconds when tested in accordance with ASTM D1692.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

A. Jobsite Requirements
   1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
   2. Maintain temperature during and after installation for minimum period of 24 hours.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Energy efficiency:
   1. Insulation: Minimum thickness in accordance with ASHRAE 90.1. Provide additional thickness to ensure surface temperatures are below 100 degrees and to prevent condensation on cold surfaces.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

A. Cellular Foam
   1. Manufacturers:
      a. Armstrong World Industries, Inc, Lancaster, PA (800) 448-1405.
      b. Other acceptable manufacturers offering equivalent products.
         1) Halstead Industries, Inc.
         2) Rubatex Corporation, Armaflex II.
   2. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.

a. 'K' ('ksi') Value: ASTM C177 or C518; 0.27 at 75 degrees F,
b. Minimum Service Temperature: -40 degrees F.
c. Maximum Service Temperature: 220 degrees F.
d. Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
e. Moisture Vapor Transmission: ASTM E96; 0.20 perm inches.
f. Maximum Flame Spread: ASTM E84; 25.
g. Maximum Smoke Developed: ASTM E84; 50.
h. Connection: Waterproof vapor barrier adhesive.

3. Elastomeric Foam Adhesive
   a. Manufacturers:
      1) Dow U.S.A.
      2) H. B. Fuller Co.
      3) Rubatex Corporation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify that piping has been tested before applying insulation materials.
   2. Verify that surfaces are clean, foreign material removed, and dry.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION - PIPING INSULATION

A. Install materials in accordance with manufacturer's instructions and ASHRAE 90.1.

B. On exposed piping, locate insulation and cover seams in least visible locations.

C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory applied or field applied.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
   3. PVC fitting covers may be used.
   4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
   5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. For insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
   3. Finish with glass cloth and adhesive.
   4. PVC fitting covers may be used.

5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

E. Inserts and Shields:
1. Application: Piping 3 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

F. Finish insulation at supports, protrusions, and interruptions.

G. For all insulated piping located 8 feet and below, provide a PVC jacket. For all exposed insulated piping above 8 feet finish with manufacturer's standard all-service jacket for fiberglass pipe. No jacket required for elastomeric foam insulation.

H. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

I. For buried piping, use elastomeric foam insulation only.

J. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 CONSTRUCTION

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

B. Cellular Foam Insulation Schedule

PIPING SYSTEMS	PIPE SIZE Inch	THICKNESS Inch
Plumbing Systems:		
Hydronic hot water supply	All	2"
Hydronic hot water recirc	All	2"
Tempered Domestic Water Supply	All	3/8"
Tempered Domestic Water Recirc	All	3/8"
Domestic Cold Water	All	3/8"
Moisture Condensate Drains - Above Grade	All	3/4"
Horizontal Waste Lines from AC Equipment	All	3/4"
HVAC Refrigerant Lines (suction only)	All	3/4"
Other Systems:		
Piping exposed to freezing with heat tracing	All	1"

END OF SECTION

SECTION 230800

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Systems and equipment testing and start-up.

B. Validation of proper and thorough installation of Division 23 systems and equipment.

C. Systems balancing verification.

D. Pre-functional performance testing of equipment and systems.

E. Documentation of tests, procedures, and installations.

F. Coordination of Training Events.

G. Generic Start-Up Procedures for mechanical systems and equipment.

1.2 GENERAL DESCRIPTION

A. Commissioning (Cx) is the process of ensuring that all building systems are installed and perform interactively according to the design intent; that systems are efficient and cost effective and meet the owner's operational needs; that the installation is adequately documented; and that the Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building systems from installation to full dynamic operation and optimization.

B. The USPS shall retain an independent Commissioning Authority (CxA) to provide Commissioning Services, or have Solicitation A/E for Design-Build Project or Design A/E for Design-Bid-Build Project hire the CxA.

C. This Section outlines the Cx procedures specific to the Division 23 Contractors. Requirements common to all work are described in Specifications 019113.

1.3 SCOPE

A. The following equipment and/or systems may be commissioned if in compliance with the guidelines provided in Specifications 019113, or with Contracting Officer approval:
1. Roof Top Units
2. Split System Air Handling Units
3. Finned-Tube Radiators
4. Cabinet Unit Heaters
5. Exhaust Fans
6. Modular Boiler Plant

1.4 RELATED WORK AND DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section

B. Commissioning Plan: The Cx Plan shall be available for reference as it outlines responsibilities outside of the Construction Contract. It provides the Contractor and the Owner an understanding of the planned commissioning activities for that project.

C. Section 013300 - Submittal Procedures: Stipulates additional copies of submittals to be submitted and refers to other sections for additional submittal requirements related to Cx.

D. Section 017704 - Closeout Procedures and Training: Defines the milestones in completion incorporating the Cx process.

E. Section 019113 – General Commissioning Requirements: Specifies the general facility commissioning procedures common across all Divisions and the Contractor's responsibilities for the commissioning process.

F. Individual Specification Sections: Individual sections stipulate installation, start-up, warranty, O&M documentation, and training requirements for the system or device specified in the Section.

G. Section 250804 – Building Automation System Commissioning: Details the commissioning procedures specific to the BAS.

H. Section 220800 – Commissioning of Plumbing: Details the commissioning procedures specific to the Plumbing Systems.

I. Section 260800 – Commissioning of Electrical Systems: Details the commissioning procedures specific to Division 26 work.

1.5 REFERENCE STANDARDS

A. ASHRAE Guideline 0-2005, "Guideline for Commissioning HVAC Systems"

B. National Environmental Balancing Bureau (NEBB)

C. AABC Commissioning Group (ACG)

D. National Fire Protection Association (NFPA)

1.6 DOCUMENTATION

A. In addition to the documentation required in Section 019113, Contractor shall provide to the CxA the following per the procedures specified herein and in other Sections of the specification:
   1. HVAC Balancing Plan
   2. All referenced charts such as vibration severity chart and room noise criteria (NC) curves.
   3. Vibration Severity Charts
   4. Factory Test Reports: Contractor shall provide any factory testing documentation or certified test reports required by the specifications. These shall be provided prior to Acceptance Phase. Factory Test Reports should be provided in PDF electronic format. These may include but are not limited to:
      a. Air Handling Units
      b. Variable Frequency Drives
      c. Fans Capacity
      d. Fan Sound Power Levels
      e. Pump Capacity
   5. Field Testing Agency Reports (other than TAB): Provide all documentation of work of independent testing agencies required by the specification. These shall be provided prior to Acceptance Phase. Field Testing Agency Reports should be provided in PDF electronic format. These may include but are not limited to:
      a. Pipe Pressure Testing

b. Duct Leakage Testing
c. Vibration Testing
d. Generated Noise and Resultant Noise Level
e. Corrosion Protection
f. Water Treatment

6. Completed Test and Balance Reports.

1.7 CONTRACTOR RESPONSIBILITIES

A. Refer to Section 019113: Detailed Contractor responsibilities common to all Divisions are specified in this Section. The following are additional responsibilities or notable responsibilities specific to Division 23.

B. Acceptance Phase
1. Assist CxA in functional performance testing. Assistance will generally include the following:
a. Manipulate systems and equipment to facilitate testing (as dictated in the Commissioning Plan; in some cases this will entail only an initial sample);
b. Provide any specialized instrumentation necessary for functional performance testing;
c. Manipulate BAS and other control systems to facilitate functional performance testing (as dictated Specification 250804; in some cases this will entail only an initial sample).
2. Provide a TAB technician to work at the direction of CxA for up to 24 hours beyond assistance specified above.
3. Provide a BAS technician to work at the direction of CxA for additional hours as specified in Section 250804.
4. Maintain trends and monitor the facility throughout the Endurance Period as specified in Section 250804.
5. Respond to all Action Items which are assigned to the respective Division 23 Contractors. Response shall be via the Project Portal or by response to the original Action Item E-mail.
6. Resolve all deficiencies which are determined to be within the Division 23 scope of work.

C. Warranty Phase
1. Maintain record documentation of any configurations, set ups, parameters etc, that change throughout the period.
2. Provide representative for off season testing as required by CxA.
3. Respond to Warranty issues as required by Division 1 and the General Conditions.

1.8 EQUIPMENT SUPPLIER RESPONSIBILITIES

A. Refer to Section 019113.

1.9 CONTRACTOR NOTIFICATION AND SCHEDULING

A. Refer to Section 019113.

1.10 START-UP PROCEDURES AND DOCUMENTATION

A. Refer to Section019113 and as detailed in Section 3 below.

1.11 EQUIPMENT NAMEPLATE DATA

A. Refer to Division 1.

1.12 BAS TRENDING REQUIREMENTS

A. Trending requirements are specified in Section 250804.

1.13 FUNCTIONAL PERFORMANCE TESTING

A. Contractor shall participate in the initial samples of Functional Performance Testing as stipulated in Section 019113 and the Commissioning Plan.

1.14 FPT ACCEPTANCE CRITERIA

A. Acceptance criteria for tests are indicated in the specifications applicable to the systems being tested. Generally, unless indicated otherwise, the criteria for acceptance will be that specified with the individual system, equipment, component, or device.

1.15 TRAINING

A. Contractors, Subcontractor, Vendors, and other applicable Parties shall prepare and conduct training sessions on the installed systems and equipment they are responsible for the requirements of Section 019113 and the individual Specifications.

1.16 O&M MANUAL

A. Refer to Division 1 and 019113 and the individual Specifications.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

A. General: All testing equipment used by any Party shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:

B. Standard Testing Instrumentation: Standard instrumentation used for testing air and water flows, temperatures, humidity, noise levels, amperage, voltage, and pressure differential in air and water systems shall be provided by CxA.

C. Special Tools: Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and turned over to the Owner upon project completion.

2.2 TEST KITS FOR METERS AND GAGES

A. Test kits for meters and gages shall be provided to the Owner new and in good condition. Previously used kits will be unacceptable. Kits shall be submitted prior to the Acceptance Phase. Kits included shall be as a minimum:
   1. Digital indication of temperature and pressure with associated sensors to work with the P/T test ports
   2. Companion readout kit (with fittings) for calibrated balancing valve with ranges as required by all devices on this project

PART 3 - EXECUTION

3.1 START-UP PROCEDURES - GENERAL

A. This Section outlines 'generic' or minimally acceptable Start-Up Procedures and individual systems. These items shall provide a minimum or guideline for the Contractor to determine the level of care required for start-up of the systems. The CxA will provide draft start-up sheets and the Contractor shall synthesize their own internal quality control practices, those of the manufacturer, and any applicable codes and standards to supplement the draft sheets for project-specific application. These supplemented procedures will be turned over to the CxA for development of the project-specific start-up procedures.

B. The following start up verifications/procedures are common to all systems
1. Checkout shall proceed from devices to the components to the systems.
2. Verify labeling is affixed per spec and visible
3. Verify prerequisite procedures are done.
4. Inspect for damage and ensure none is present.
5. Verify system is applied per the manufacturer's recommendations
6. Verify system has been start up per the manufacturer's recommendations
7. Verify that access is provided for inspection, operation and repair
8. Verify that access is provided for replacement of the equipment
9. Verify the record drawings, submittal data and O&M documentation accurately reflect the installed systems
10. Verify all gages and test ports are provided as required by contract documents and manufacturer's recommendations
11. Verify all recorded nameplate data is accurate
12. Installation is done to ensure safe operation and maintenance.
13. Verify specified replacement material/attic stock has been provided as required by the Construction Documents
14. Verify all rotating parts are properly lubricated
15. Verify all monitoring and ensure all alarms are active and set per Owner's requirements

3.2 OBSERVATION AND TESTING REQUIREMENTS

Equipment or Systems	**Sampling Rate**
HVAC Systems	
Air Handling Units	25%
Exhaust Fan Systems	25%
Ventilation Fans	25%
VFDs	25%
Air Terminal Units	25%
Ductwork	20%
Temperature Control	25%
Ventilation Control	25%
Condensing Boilers	25%
Hydronic Pumps	100%
Hydronic Piping Systems	25%
Effluent Decontamination System	25%
Building Automation Systems	
Temperature/Humidity Sensors	25%
Pressure Sensors and Controllers	25%
Sequence of Operation (all different sequences)	100%
Airflow Stations	25%

Damper/Valve Actuators	25%

Electrical Systems

Medium Voltage Switchgear and Unit Substations	50%
Normal Power Electrical Systems	25%
Emergency Power Systems	100%
Fire Alarm System	100%
Lighting Systems and Control	100%
Sub-metering	100%

END OF SECTION

SECTION 230905

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HVAC system thermostats.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

1.2 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
   1. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module
   2. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system. Submittals shall be furnished as a complete package prior to installation.

B. Section 017704 - Closeout Procedures and Training: Procedures for close-out submittals.
   1. Project Record Documents: Accurately record the following:
      a. Actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
   2. Submit written special warranty with forms completed in United States Postal Service name and registered with manufacturer as specified in this Section.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:

1. Grid Point, Inc., Roanoke, VA 866-800-8906.
2. Carrier Corp., Miami, FL (305) 590-1000.
3. Lennox, Dallas, TX (214) 497-5000.
4. Trane Co., Lacrosse, WI (608) 787-2000.
5. York, York, PA (717) 771-6225.
6. Honeywell, Minneapolis, MN (800) 328-5111.
7. White Rodgers, St. Louis, MO (314) 577-1300.

B. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.2 REMOTE MONITORING SYSTEM (EEMS,where required)

A. Manufacturer
1. Supplier: Grid Point, Inc., Roanoke, VA 866-800-8906
2. Substitutions: As allowed by the Contracting Officer's Representative (COR)

B. Thermostats used shall be low voltage, digital, two-way communicating thermostats configurable for monitoring electric systems, heat pump systems, gas packs, packaged units, air handlers, etc.
a. Microprocessor based
b. Temporary manual override of space temperature
c. Battery backup

C. Sensors/meters used shall be low voltage, digital, with battery backup and capable of measuring the following parameters, either individually or collectively (see drawings for specific application):
a. Supply air temperature (-20°C to +70°C)
b. Runtime by stage
c. Differential Pressure (air filter condition)
d. Electrical load
e. Space temperature (-20°C to +70°C)
f. Relative humidity (0-95% RH non-condensing)
g. CO_2 sensing
h. Building pressure
i. Light intensity
j. Outside air temperature

D. Controller shall be a centralized device that networks thermostats, sensors, advanced meters and submeters for remote access via (1) 56K RJ-11 phone line and (1) 10/100 RJ-45 Ethernet port in native BACnet protocol. Monitoring of the building HVAC performance parameters shall be accessible via the web. The controller shall have the following features and capabilities:
a. Touch screen interface for local access.
b. Revenue grade accuracy in accordance with ANSI C12.1.
c. Lockout of local override capabilities
d. Remote control of schedule and set points.
e. Collect, analyze and report, per phase when applicable, voltage, current, reactive power, real power, apparent power, power factor, frequency, and total harmonic distortion (THD) via analog and/or digital inputs.
f. Collect and automatically analyze trends and perform demand limiting functions.
g. Integrated submetering of standard HVAC performance metrics, such as kWh, kW, Amperage, Voltage, Power Factor, etc.
h. Data collected and analyzed shall be viewable via a web based graphical interface (charting/graphing/dashboard) without the need to download any software.
i. Operational parameters shall be capable of being remotely changed.
j. Provide alarm notification by email when kW thresholds are exceeded.

2.3 ELECTRONIC TIME CLOCKS:

A. Timeclock for headbolt heater control shall be a single channel SPDT 7 day electronic programmable controller with up to minimum 2 on and 2 off times for each day of the week. Timeclock shall have COPY DAY function to speed programming, manual override of programming through single override button. Timeclock shall have at least 48 hour battery backup of memory retention in the event of power interruption. Timeclock abbreviated operating instructions shall be printed on inside of timeclock cover

2.4 ELECTRIC THERMOSTATS:

A. Electric Thermostats for headbolt heater control shall be low voltage 24 volt, with a 0 degrees F. to 100 degrees F. range, 3 degrees F. to 10 degrees F. adjustable differential, remote non-mercury bulb type with 5 foot copper capillary. Spdt switch that makes on fall. Mounted in heavy metal case.

B. Electric Thermostats for Dock Unit heater control shall be low voltage, 24 volt, rated and suitable for the application, coiled bimetal element, switch with adjustable heat anticipator, that is non-mercury based, setting lever (55 degrees F to 95 degrees F. range), . Mounted in heavy ventilated metal enclosure at 78 inches above floor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. At contract award, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the USPS.

3.2 INSTALLATION:

A. Provide new control wiring as required for proper operation. All control wires installed under this contract shall be color coded, numbered or otherwise labeled for easy identification. All control wiring exposed to damage in workrooms shall be installed in conduit painted to match the mounting surface. All control wiring exposed in offices or other public spaces shall be installed in wiremold painted to match the mounting surface. All concealed control wiring shall be plenum rated. Provide and install batteries as required for proper operation. New installation shall be in accordance with manufacturer's recommendations.

B. Provide all necessary transformers, relays, contactors and other options as required for proper operation.

C. Mount new thermostats at 78 inches above the floor in workroom spaces subject to damage from operations. Mount new thermostats at 54 inches above the floor in office and public areas.

3.3 SYSTEM PERFORMANCE

A. Thermostats including batteries, temperature controllers, relays, switches, and 24 volt wiring to be furnished and installed by the Heating Contractor, unless furnished with the equipment.

B. The temperature control system is to maintain space temperature settings, within plus or minus 1 degree F. of space thermostat settings.

3.4 TEMPERATURE CONTROL SYSTEM OPERATION

A. The temperature control system for split system air conditioning systems and package rooftop air conditioning systems shall control the operation of the heating and ventilating and air conditioning system as follows:

B. Constant Volume Rooftop Unit (RTU-1 & RTU-2)

1. In the “Occupied” mode, the outside air damper opens to the minimum ventilation position and the supply air fan runs continuously. The unit’s internal controls initiate DX cooling and gas-fired furnace control sequences to maintain heating and cooling setpoint temperatures. As space temperature rises above the cooling setpoint, refrigeration controls shall activate to provide cooling. When space temperature drops below the heating setpoint, the refrigeration controls de-energize and the gas-fired furnace activates to provide heat.
2. In the “Unoccupied” mode, the outside air damper closes and the supply air fan, heating & cooling controls cycle to maintain unoccupied setup or setback temperatures.
3. The economizer shall be enabled on a call for cooling when enthalpy of outside air is lower than enthalpy of inside air. Where outside air capability is provided, set minimum position to be at 5 percent when fan is ON.
4. Smoke Detection Shutdown: The duct mounted smoke detector shall deactivate the unit upon detection of smoke via hardwire shutdown.

C. Split System Heat Pump Air Conditioning Unit (AHU-1/HP-1)

1. In the “Occupied” mode, the outside air damper opens to minimum ventilation position and the supply air fan funs continuously. The heat pump cycles to maintain cooling or heating setpoint temperatures. As space temperature rises above the cooling setpoint, the heat pump shall activate to provide cooling. When space temperature drops below the heating setpoint, the heat pump shall reverse the process in the coils and heat the space. As thermostat calls for additional heat or outdoor air temperature is too low for efficient heat operation, the electric heating coil shall activate to provide auxiliary heat.
2. In the “Unoccupied” mode, the outside air damper shall close and the supply air fan cycles to maintain unoccupied setup or setback temperatures.
3. The economizer shall activate when the outdoor condition (enthalpy-based) is below the changeover set point, 65 degrees F (adj.).
4. Water Detection: The water detection sensor located in the auxiliary drain pan shall shut down the unit upon detection of water.
5. Smoke Detection Shutdown: The duct mounted smoke detector shall deactivate the unit upon detection of smoke via hardware shutdown.

D. At completion of the project, the Contractor shall program and completely adjust the entire temperature control system. Provide all necessary training to building personnel to include demonstration of all functions and programming capabilities of electronic thermostats and time clocks. Provide Owner’s manuals and installation manuals. Provide wiring schematic (control diagrams) showing wiring identification system. Contractor shall obtain a signed receipt that the Owner has received the instruction manuals and complete instruction on the operation of the system

E. Operation Instructions

1. Provide on-site instruction to review the operation of the system and detail any common troubleshooting or maintenance required to ensure normal operation.
2. Provide one complete set of equipment operating, installation, and programming manuals that will remain at the installed location.

3.5 HOT WATER SYSTEM

A. The hot water system is comprised of two modular gas fired boilers (B-1 & B-2), two boiler circulation pumps, and two hot water circulating pumps (HWP-1 & HWP-2). Hot water is distributed to finned-tube radiators and recessed cabinet unit heaters.

B. High efficiency modular gas fired boilers are in Standby mode when there is no call for heat. When a call for heat is detected:
   1. Start min/max on timers.
   2. Start boiler circulating pumps. HWP-1 and HWP-2 shall energize respectively to establish water flow throughout the system.
   3. Unit controller measures target temperature. If temperature sensor detects temperature below target, unit initiates firing sequence. Multiple boiler control sequence established.
   4. Blower to ignition speed for pre-purge. After pre-purge times out, begin ignition cycle and activate gas valve & ignition spark.
   5. When flame is detected, boiler holds at low fire, then released for modulation.
   6. Boilers stage and modulate burner firing rates to reset supply water temperatures to the system based on the outdoor air temperature.
   7. When demand is satisfied, unit goes into post-purge sequence. Gas valve shuts off, blower to ignition speed for post-purge, and return to standby mode.

C. Hot Water Pump (HWP-1 & HWP-2) shall be operated by HAND-OFF-AUTO switch located in the system control panel. In the “OFF” position pumps are deactivated. In the “HAND” position pump is activated and shall run continuously regardless of BAS control output signals. In the “AUTO” position the pump(s) is controlled by the BAS as follows:
   a. Pumps HWP-1 and HWP-2 operate on an “Active/Standby” arrangement as described for Active/Standby Pump Operation.
   b. The active hot water pump runs continuously. BAS shall vary the speed of the pumps to maintain the lowest differential pressure setpoint.
   c. The pump operation shall also include an operator-initiated time clock function which will cycle the pump from “Occupied” to “Unoccupied” modes of operation when heat is not required.
   d. Hot Water Reset: The hot water supply temperature modulates linearly based on the outdoor air temperature or the demand of the building.

Outdoor Temperature	Supply Water Temperature Setpoint
0^{o}F	160ºF
60ºF	100ºF (adj.)

   e. Boiler Emergency Shutoff Switch: Provide palm strike switch with cover at Mechanical Room entrance to shutoff boilers. Label switch “Emergency Boiler Shut-Off

2. Active/Standby Pump Operation (HWP-1 & HWP-2):

   a. Each pump group shall be controlled though the DDC controller with an Active/Standby rotation function, Scheduling function and a Temperature function. The scheduling and temperature functions are to be programmed as parallel conditions; anyone may start and run the active pump.

b. The Active/Standby status of the pumps shall be rotated through the DDC automatically based on a program to equalize pump run times. Automatic active pump rotation shall occur once a week at a time coordinated with the building engineer. The initial time shall be 7:00 am on Monday (adjustable).

c. Upon detection of pump failure via a pump DP switch or a loss of water flow as detected via the system water flow switch the DDC shall initiate a “Pump Failure” sequence. This sequence shall consist of 30 second delay during which the DDC continues to monitor the pump status and/or water flow. After this delay if the DDC still detects a failure the DDC shall start the standby pump and shut down the active pump. A message shall be recorded to indicate the problem detected and the automatic pump rotation to continue operation

D. Cabinet Unit Heaters (CUH-1, CHU-2, and CUH-3)

1. Unit mounted temperature sensor with ON-OFF-AUTO switch to modulate fan speed and 2-way control valve to maintain space set point temperature.
   a. ON: Fan runs continuously. 2-way valve modulates to maintain heating set point.
   b. OFF: Fan de-energized and 2-way control valve closed.
   c. AUTO: Fan cycles and 2-way control valve modulates to maintain heating set point.

E. Finned-Tubed Radiators (FTR-#-#)

1. Wall mounted space temperature sensor modulates 2-way and 3-way control valve to maintain space set point temperature. Refer to floor plan for 3-way control valve locations.

END OF SECTION

SECTION 231123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 5 psig.

C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 5 psig, and is reduced to secondary pressure of 0.5 psig or less.

D. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of seismic restraints.
   2. Design Calculations: Calculate requirements for selecting seismic restraints.

D. Welding certificates.

E. Field quality-control reports.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
      a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
   1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
      a. OmegaFlex, Inc.
      b. Parker Hannifin Corporation; Parflex Division.
      c. Titeflex.
      d. Tru-Flex Metal Hose Corp.
      e. <Insert manufacturer's name>.
   2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
   3. Coating: PE with flame retardant.
      a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

         1) Flame-Spread Index: 25 or less.
         2) Smoke-Developed Index: 50 or less.
   4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
   5. Striker Plates: Steel, designed to protect tubing from penetrations.
   6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.

C. PE Pipe: ASTM D 2513, SDR 11.
   1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
   2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
    c. Aboveground Portion: PE transition fitting.
    d. Outlet shall be threaded or suitable for welded connection.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    b. Outlet shall be threaded or suitable for welded connection.
    c. Bridging sleeve over mechanical coupling.
    d. Factory-connected anode.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
   f. <Insert manufacturer's name>.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.

4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Kerotest Manufacturing Corp.
   b. Lyall, R. W. & Company, Inc.
   c. Perfection Corporation; a subsidiary of American Meter Company.
   d. <Insert manufacturer's name>.
2. Body: PE.
3. Ball: PE.
4. Stem: Acetal.
5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: 80 psig.
8. Operating Temperature: Minus 20 to plus 140 deg F.
9. Operator: Nut or flat head for key operation.
10. Include plastic valve extension.
11. Include tamperproof locking feature for valves where indicated on Drawings.

F. Valve Boxes:
1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25, where required by local codes or ordinance.
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Vanguard Valves, Inc.
   b. Pacific Seismic Products, Inc.
2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 5 psig.
4. Cast-aluminum body with nickel-plated chrome steel internal parts.
5. Nitrile-rubber valve washer.
6. Sight windows for visual indication of valve position.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall mounting bracket with bubble level indicator.

2.6 PRESSURE REGULATORS

A. General Requirements:
   1. Single stage and suitable for natural gas.
   2. Steel jacket and corrosion-resistant components.
   3. Elevation compensator.
   4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
   1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
      a. Actaris.
      b. American Meter Company.
      c. Eclipse Combustion, Inc.
      d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
      e. Invensys.
      f. Maxitrol Company.
      g. Richards Industries; Jordan Valve Div.
   2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
   3. Springs: Zinc-plated steel; interchangeable.
   4. Diaphragm Plate: Zinc-plated steel.
   5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
   6. Orifice: Aluminum; interchangeable.
   7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
   8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
   9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
   10. Overpressure Protection Device: Factory mounted on pressure regulator.
   11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
   12. Maximum Inlet Pressure: As designed.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
   1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
      a. Canadian Meter Company Inc.
      b. Eaton Corporation; Controls Div.
      c. Harper Wyman Co.
      d. Maxitrol Company.
      e. SCP, Inc.
   2. Body and Diaphragm Case: Die-cast aluminum.
   3. Springs: Zinc-plated steel; interchangeable.
   4. Diaphragm Plate: Zinc-plated steel.
   5. Seat Disc: Nitrile rubber.
   6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
   7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
   8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
   9. Maximum Inlet Pressure: As designed.

2.7 DIELECTRIC UNIONS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   1. Capitol Manufacturing Company.
   2. Central Plastics Company.
   3. Hart Industries International, Inc.
   4. McDonald, A. Y. Mfg. Co.
   5. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   6. Wilkins; Zurn Plumbing Products Group.
   7. <Insert manufacturer's name>.

B. Minimum Operating-Pressure Rating: 150 psig.

C. Combination fitting of copper alloy and ferrous materials.

D. Insulating materials suitable for natural gas.

E. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.8 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.9 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. Calpico Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
   3. Pressure Plates: Stainless steel.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.10 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54, the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
   3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:
   1. Apply joint cover kits over tubing to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Exterior-Wall Pipe Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

H. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.2 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54, the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

L. Verify final equipment locations for roughing-in.

M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
   1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
   2. Bevel plain ends of steel pipe.
   3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

B. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
   2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
   3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.6 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas according to NFPA 54, the International Fuel Gas Code and authorities having jurisdiction.

B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

B. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground, distribution piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

B. Underground, below building, piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be[one of] the following:
1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.

C. Valves in branch piping for single appliance shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.

END OF SECTION

SECTION 232113

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Water piping to connect HVAC equipment, including the following:
   1. Heating hot water and drain piping.
   2. Extension of domestic water make-up piping for HVAC systems.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
   B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150 and 300
   B16.4-2011.....Gray Iron Threaded Fittings: (Classes 125 and 250)
   B16.5-2013.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
   B16.9-2012.....Factory Made Wrought Buttwelding Fittings
   B16.11-2011.....Forged Fittings, Socket-Welding and Threaded
   B16.18-2012.....Cast Copper Alloy Solder Joint Pressure Fittings
   B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
   B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
   B16.39-2014.....Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300
   B16.42-06.....Ductile Iron Pipe Flanges and Flanged Fittings
   B31.9-2014.....Building Services Piping
   B40.100-2013.....Pressure Gauges and Gauge Attachments

B. American Society for Testing and Materials (ASTM):
   A47/A47M-1999 (R2014) .....Standard Specification for Ferritic Malleable Iron Castings
   A53/A53M-2012 .....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   A106/A106M-2015 .....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
   A126-2004 (R2014).....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
   A183-2014.....Standard Specification for Carbon Steel Track Bolts and Nuts
   A216/A216M-2014e1 .....Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
   A307-2014.....Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
   A536-1984 (R2014).....Standard Specification for Ductile Iron Castings
   B62-2015.....Standard Specification for Composition Bronze or Ounce Metal Castings
   B88-2014.....Standard Specification for Seamless Copper Water Tube
   F439-2013.....Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
   F441/F441M-2015.....Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

C. American Welding Society (AWS):
   B2.1/B2.1M-2014 .....Standard for Welding Procedure and Performance Specification

D. Expansion Joint Manufacturer's Association, Inc. (EJMA):
EJMA.....Expansion Joint Manufacturer's Association Standards, Tenth Edition

E. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:
SP-67-2011 .....Butterfly Valves
SP-70-2011 .....Gray Iron Gate Valves, Flanged and Threaded Ends
SP-71-2011 .....Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-80-2013 .....Bronze Gate, Globe, Angle, and Check Valves
SP-85-2011 .....Gray Iron Globe and Angle Valves, Flanged and Threaded Ends
SP-110-2010 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-125-2010 .....Gray Iron and Ductile Iron In-line, Spring-Loaded, Center-Guided Check Valves

F. Tubular Exchanger Manufacturers Association (TEMA):
TEMA Standards-2007.....9th Edition

1.3 SUBMITTALS

A. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
1. Pipe and tubing, with specification, class or type, and schedule.
2. Valves of all types.
3. Strainers.
4. Expansion joints.
5. Expansion compensators.
6. All specified hydronic system components.
7. Water flow measuring devices.
8. Gauges.
9. Thermometers and test wells.

B. Submit the welder's qualifications in the form of a current (less than one-year old) and formal certificate.

1.4 QUALITY ASSURANCE

A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one-year old.

C. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.
1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 230500, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

A. Heating Hot Water and Vent Piping:
1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
2. Copper water tube option: ASTM B88, Type K or L, hard drawn.

B. Extension of Domestic Water Make-up Piping: ASTM B88, Type K or L, hard drawn copper tubing.

C. Cooling Coil Condensate Drain Piping:
   1. From air handling units: Copper water tube, ASTM B88, Type M, or Schedule 40 PVC plastic piping.
   2. From fan coil or other terminal units: Copper water tube, ASTM B88, Type M for runouts and Type L for mains.

D. Chemical Feed Piping for Condenser Water Treatment: CPVC, Schedule 80, ASTM F441/F441M.

2.3 FITTINGS FOR STEEL PIPE

A. 2 inches and Smaller: Screwed or welded joints.
   1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
   2. Forged steel, socket welding or threaded: ASME B16.11.
   3. Screwed: 150-pound malleable iron, ASME B16.3. 125-pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
   4. Unions: ASME B16.39.
   5. Water hose connection adapter: Brass, pipe thread to 3/4 inch garden hose thread, with hose cap nut.

B. 2-1/2 inches and Larger: Welded or flanged joints.
   1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
   2. Welding flanges and bolting: ASME B16.5:
      a. Water service: Weld neck or slip-on, plain face, with 1/8 inch thick full-face neoprene gasket suitable for 220 degrees F.
         1) Contractor's option: Convoluted, cold formed 150-pound steel flanges, with Teflon gaskets, may be used for water service.
      b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gauge connections.

2.4 FITTINGS FOR COPPER TUBING

A. Joints:
   1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
   2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
   3. Piping under 4” diameter: Press-connect: Ensure the piping reveals no surface imperfection. Select the proper size and type of pressing jaw depending on the piping application.

B. Bronze Flanges and Flanged Fittings: ASME B16.24.

C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.5 FITTINGS FOR PLASTIC PIPING

A. Schedule 40, socket type for solvent welding.

B. Schedule 40 PVC drain piping: Drainage pattern.

C. Chemical feed piping for condenser water treatment: CPVC, Schedule 80, ASTM F439.

2.6 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

B. 2 inches and Smaller: Threaded dielectric union, ASME B16.39.

C. 2-1/2 inches and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.

D. Temperature Rating, 210 degrees F.

2.7 SCREWED JOINTS

A. Pipe Thread: ASME B1.20.1.

B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.8 VALVES

A. Asbestos packing is not acceptable.

B. All valves of the same type shall be products of a single manufacturer.

C. Provide chain operators for valves 6 inches and larger when the centerline is located 8 feet or more above the floor or operating platform.

D. Shut-Off Valves:
1. Ball Valves (Pipe sizes 2 inch and smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat. Provide stem extension to allow operation without interfering with pipe insulation.
2. Butterfly Valves (Pipe Sizes 2-1/2 inch and larger): Provide stem extension to allow 2 inches of pipe insulation without interfering with valve operation. MSS SP-67, flange lug type rated 175 psig working pressure at 200 degrees F. Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Butterfly valves are prohibited for direct buried pipe applications.
   a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
   b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
   c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
      1) Valves 6 inches and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
      2) Valves 8 inches and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.
      3) Gate Valves:
         a) 2 inches and smaller: MSS SP-80, Bronze, 150 psig, wedge disc, rising stem, union bonnet.
         b) 2-1/2 inches and larger: Flanged, outside screw and yoke. MSS SP-70, iron body, bronze mounted, 125 psig wedge disc.

E. Globe and Angle Valves:
   1. Globe Valves:
      a. 2 inches and smaller: MSS SP-80, bronze, 150 psig. Globe valves shall be union bonnet with metal plug type disc.
      b. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for globe valves.
   2. Angle Valves:
      a. 2 inches and smaller: MSS SP-80, bronze, 150 psig. Angle valves shall be union bonnet with metal plug type disc.
      b. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for angle.

F. Check Valves:
   1. Swing Check Valves:
      a. 2 inches and smaller: MSS SP-80, bronze, 150 psig, 45-degree swing disc.
      b. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-71 for check valves.
   2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
      a. Body: MSS SP-125 cast iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM 536, flanged or wafer type.
      b. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

G. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.
   1. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
   2. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

H. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of 4 to 57 psig. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:
   1. Gray iron ASTM A126 or brass body rated 175 psig at 200 degrees F, with stainless steel piston and spring.
   2. Brass or ferrous body designed for 300 psig service at 250 degrees F, with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
   3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.
   4. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.

I. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.9 WATER FLOW MEASURING DEVICES

A. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.

B. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.

C. Wafer Type Circuit Sensor: Cast iron wafer-type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.

D. Self-Averaging Annular Sensor Type: Brass or stainless-steel metering tube, shutoff valves and quick-coupling pressure connections. Metering tube shall be rotatable, so all sensing ports may be pointed down-stream when unit is not in use.

E. Flow Measuring Device Identification:
   1. Metal tag attached by chain to the device.
   2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate.

F. Portable Water Flow Indicating Meters:
   1. Minimum 6 inch diameter dial, forged brass body, beryllium-copper bellows, designed for 175 psig working pressure at 250 degrees F.
   2. Bleed and equalizing valves.
   3. Vent and drain hose and two 10 feet lengths of hose with quick disconnect connections.
   4. Factory-fabricated carrying case with hose compartment and a bound set of capacity curves showing flow rate versus pressure differential.
   5. Provide one portable meter for each range of differential pressure required for the installed flow devices.

G. Permanently Mounted Water Flow Indicating Meters: Minimum 6 inch diameter, or 18 inch long scale, for 120 percent of design flow rate, direct reading, with three valve manifold and two shut-off valves.

2.10 STRAINERS

A. Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 0.045 inch diameter perforations for 4 inches and larger: 1/8 inch diameter perforations.

2.11 FLEXIBLE CONNECTORS FOR WATER SERVICE

A. Flanged Spool Connector:
   1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
   2. Working pressures and temperatures shall be as follows:
      a. Connector sizes 2 inches to 4 inches, 165 psig at 250 degrees F.
      b. Connector sizes 5 inches to 12 inches, 140 psig at 250 degrees F.
   3. Provide ductile iron retaining rings and control units.

2.12 EXPANSION JOINTS

A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.

B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association (EJMA) Standards.

C. Bellows - Internally Pressurized Type:
   1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
   2. Internal stainless-steel sleeve entire length of bellows.
   3. External cast iron equalizing rings for services exceeding 50 psig.
   4. Welded ends.
   5. Design shall conform to standards of EJMA and ASME B31.9.

6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
7. Integral external cover.

D. Bellows - Externally Pressurized Type:
1. Multiple corrugations of Type 304 stainless steel.
2. Internal and external guide integral with joint.
3. Design for external pressurization of bellows to eliminate squirm.
4. Welded ends.
5. Conform to the standards of EJMA and ASME B31.9.
6. Threaded connection at bottom, 1 inch minimum, for drain or drip point.
7. Integral external cover and internal sleeve.

E. Expansion Compensators:
1. Corrugated bellows, externally pressurized, stainless steel or bronze.
2. Internal guides and anti-torque devices.
3. Threaded ends.
4. External shroud.
5. Conform to standards of EJMA.

F. Expansion Joint: 350 psig maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with welded or flanged ends, suitable for axial end movement to 3 inch.

G. Expansion Joint Identification: Provide stamped brass or stainless-steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.

H. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

I. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

2.13 HYDRONIC SYSTEM COMPONENTS

A. Air Purger: Cast iron or fabricated steel, 125 psig water working pressure, for in-line installation.

B. Tangential Air Separator: ASME BPVC Section VIII construction for 125 psig working pressure, flanged tangential inlet and outlet connection, internal perforated stainless-steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. If scheduled on the drawings, provide a removable stainless-steel strainer element having 3/16 inch perforations and free area of not less than five times the cross-sectional area of connecting piping.

C. Diaphragm Type Pre-Pressurized Expansion Tank: ASME BPVC Section VIII construction for 125 psig working pressure, welded steel shell, rustproof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 240 degrees F. Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre-charged to a minimum of 12 psig.

D. Closed Expansion (Compression) Tank: ASME BPVC Section VIII construction for 125 psig working pressure, steel, rustproof coated. Provide gauge glass, with protection guard, and angle valves with tapped openings for drain (bottom) and plugged vent (top).

1. Horizontal tank: Provide cradle supports and following accessories:
   a. Air control tank fittings: Provide in each expansion tank to facilitate air transfer from air separator, or purger, into tank while restricting gravity circulation. Fitting shall include an integral or separate air vent tube, cut to length of about 2/3 of tank diameter, to allow venting air from the tank when establishing the initial water level in the tank.
   b. Tank drainer-air charger: Shall incorporate a vent tube, cut to above 2/3 of tank diameter, and drain valve with hose connection draining and recharging with air.
2. Vertical floor-mounted expansion tank: Provide gauge glass, system or drain connection (bottom) and air charging (top) tappings. Provide gate valve and necessary adapters for charging system. Tank support shall consist of floor mounted base ring with drain access opening or four angle iron legs with base plates.

E. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 4 psig above and below set point. Bronze, brass or iron body and bronze, brass or stainless-steel trim, rated 125 psig working pressure at 225 degrees F.

F. Pressure Relief Valve: Bronze or iron body and bronze or stainless-steel trim, with testing lever. Comply with ASME BPVC Section VIII and bear ASME stamp.

G. Automatic Air Vent Valves (where shown on drawings): Cast iron or semi-steel body, 150 psig working pressure, stainless steel float, valve, valve seat and mechanism, minimum 1/2 inch water connection and 1/4 inch air outlet. Air outlet shall be piped to the nearest floor drain.

H. Buffer Tank: Buffer tank shall be constructed with a built-in baffle to allow mixing of the fluid inside the tank. Tank shall be constructed in accordance with ASME BPVC Section VIII requirements and stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. Tank shall have a working pressure of 125 psig and shall come equipped with a base ring for installing the buffer tank directly on a level surface. The tank shall be furnished with two connections, tappings for air vent, relief valve and drain. Buffer tank shall have a capacity as indicated on the drawings.

2.14 GAUGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 4-1/2 inches in diameter, 1/4 inch NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.

B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gauges in water service.

C. Range of Gauges: Provide range equal to at least 130 percent of normal operating range.
   1. For condenser water suction (compound): 30 inches Hg to 100 psig.

2.15 PRESSURE/TEMPERATURE TEST PROVISIONS

A. Pete's Plug: 1/4 inch MPT by 3 inches long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gauge test connections shown on the drawings.

B. Provide one each of the following test items:
   1. 1/4 inch FPT by 1/8 inch diameter stainless steel pressure gauge adapter probe for extra-long test plug.
   2. 3-1/2 inch diameter, one percent accuracy, compound gauge, 30 inches Hg to 100 psig range.
   3. 32 to 220 degrees F pocket thermometer one-half degree accuracy, 1 inch dial, 5 inch long stainless-steel stem, plastic case.

2.16 THERMOMETERS

A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 6 inch brass stem, straight, fixed or adjustable angle as required for each in reading.

B. Case: Chrome plated brass or aluminum with enamel finish.

C. Scale: Not less than 9 inches, range as described below, two-degree graduations.

D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.

E. Scale ranges:
   1. Hot Water and Glycol-Water: 100 to 200 degrees F.

PART 3 - EXECUTION

3.1 GENERAL

A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to USPS. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

C. Support piping securely. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.

D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 1 inch minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 1 inch in 40 feet. Provide eccentric reducers to keep bottom of sloped piping flat.

E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.

G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

H. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
   1. Water treatment pot feeders and condenser water treatment systems.
   2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

J. Thermometer Wells: In pipes 2-1/2 inches and smaller increase the pipe size to provide free area equal to the upstream pipe area.

K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.

L. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M.

B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.

C. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

D. Solvent Welded Joints: As recommended by the manufacturer.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.

B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.4 LEAK TESTING ABOVEGROUND PIPING

A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary.

B. An operating test at design pressure, and for hot systems, design maximum temperature.

C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.5 FLUSHING AND CLEANING PIPING SYSTEMS

A. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system components. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool

pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 5.9 f/s, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps.

B. Cleaning: Circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 5.9 f/s. Circulate each section for not less than 4 hours. Blow-down all strainers or remove and clean as frequently as necessary. Drain and prepare for final flushing.

C. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.6 WATER TREATMENT

A. Install water treatment equipment and provide water treatment system piping.

B. Close and fill system as soon as possible after final flushing to minimize corrosion.

3.7 STARTUP AND TESTING

A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

B. When any defects are detected, correct defects and repeat test at no additional cost or time to the USPS.

C. Adjust red set hand on pressure gauges to normal working pressure.

3.8 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative to instruct each USPS personnel responsible in operation and maintenance of the system.

END OF SECTION

SECTION 232123

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Close-coupled, in-line centrifugal pumps.

1.2 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.4 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within a minimum of 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 CENTRIFUGAL PUMPS

A. Manufacturers:
1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Bell & Gossett; Div. of ITT Industries.
4. PACO Pumps.
5. Taco, Inc.

6. Weinman; Div. of Crane Pumps & Systems.

B. Description: Factory-assembled and -tested, centrifugal, pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 250 deg F.

C. Pump Construction:
1. Casing:
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N or EPT bellows and gasket.
5. Select subparagraph above or first subparagraph below. Packing seal is rated for 200 deg F (93 deg C).
6. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
7. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. EPDM coupling sleeve for variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Permanently lubricated ball bearings are available up through 5 hp. Larger motors have grease-lubricated ball bearings.

H. Motor: Premium efficiency single speed.

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig or 300-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig or 300-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports."

E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls." Hanger and support materials are specified in Division 23 Section "Hangers and Supports."

3.2 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and throttling or triple-duty valve on discharge side of pumps.

F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Ground equipment according to Division 26 Section "Grounding and Bonding."

J. Connect wiring according to Division 26 Section "Conductors and Cables."

END OF SECTION

SECTION 232300

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUBMITTALS:

A. Product Data: Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
   1. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.
   2.

1.2 QUALITY ASSURANCE:

A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS:

A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Bronze Filler Metals: AWS A5.8, Classification BAg-1 (silver)

2.2 REFRIGERANT PIPING SPECIALITIES:

A. Replaceable-Core Filter-Dryers: 500-psig maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:
   1. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.

2. Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.
3. Pressure-Regulating Valves: Comply with ARI 770; direct acting, brass; with pilot operator, stainless-steel diaphragm, standard coil, and solder-end connection; suitable for refrigerant specified.
4. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.
5. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.
6. Hot-Gas Bypass Valve: Pulsating-dampening design, stainless-steel bellows and polytetrafluoroethylene valve seat; adjustable; sized for capacity equal to last step of compressor unloading; with solder-end connections.
7. Moisture/Liquid Indicators: 500-psig (3450-kPa) maximum working pressure and 200 deg F (93 deg C) operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS:

A. Aboveground, within Building: Type ACR drawn-copper tubing or Type L (Type B) drawn-copper tubing.

B. Belowground for NPS 2 (DN 50) and Smaller: Type K (Type A) annealed-copper tubing.

3.2 PIPING INSTALLATION:

A. Install refrigerant piping according to ASHRAE 15. Equipment manufacturer shall size refrigerant lines for Contractor.

B. Basic piping installation requirements are specified in Division 23 Section "Common Work for HVAC."

C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

G. Slope refrigerant piping as follows:
1. Install horizontal suction lines with a uniform slope downward to compressor.
2. Install traps and double risers to entrain oil in vertical runs.
3. Liquid lines may be installed level.

H. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports."

I. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.

J. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
   4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.

K. Support vertical runs at each floor.

L. Pipe Joint Construction:
   1. Braze joints according to Division 23 Section "Common Work for HVAC."
   2. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

M. Refrigerant Pipe Insulation:
   1. Insulate refrigerant piping according to Division 23 Section "Pipe Insulation."

N. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
   1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
   2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
      a. System shall maintain test pressure at the manifold gage throughout duration of test.
      b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
      c. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
      d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

O. Adjust set-point temperature of the conditioned air controllers to the system design temperature.

P. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

Q. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

R. Charge system using the following procedures:
   1. Install core in filter-dryer after leak test but before evacuation.
   2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
   3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
   4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION

SECTION 233100

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal ductwork.
2. Nonmetal ductwork.
3. Air turning devices.
4. Duct access doors.
5. Duct test holes.
6. Fire dampers.
7. Flexible duct connections.
8. Volume control dampers.
9. Duct cleaning.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

C. Related Sections:
1. Section 230500 - Common Work Results for HVAC:
2. Section 230719 - Duct Insulation: Duct Insulation.
3. Section 233713 - Diffusers Registers and Grilles:
4. Section 230593 - Testing, Adjusting and Balancing for HVAC:

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM A 36 - Structural Steel.
2. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
3. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
4. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
5. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanealed) by the Hot-Dip Process.
6. ASTM A 568 Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

B. American Welding Society (AWS):
1. AWS D9.1 - Welding of Sheet Metal.

C. National Fire Protection Association (NFPA):
1. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
3. NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying.
4. NFPA 96 - Installing of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. SMACNA - HVAC Air Duct Leakage Test Manual.
2. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

E. Underwriters Laboratories, Inc. (UL):
1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
1. Product Data:
a. Duct materials, duct liner, duct connectors, and flexible duct.
b. Factory or shop manufactured assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
1. Project Record Documents: Accurately record the following:
a. Actual locations of ducts and duct fittings.
b. Record changes in fitting location and type.
c. Show additional fittings used.
d. Actual locations of access doors, test holes, and fire dampers.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

B. Qualifications:
1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

C. Regulatory Requirements: Construct ductwork to NFPA 90A. NFPA 90B, and NFPA 96 standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

B. Protect dampers from damage to operating linkages and blades.

1.7 PROJECT CONDITIONS OR SITE CONDITIONS

A. Jobsite Requirements:

1. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
2. Maintain temperatures during and after installation of duct sealants.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Environmental Impact:
1. Indoor Air Quality: Install insulation so that unfaced fiberglass and mineral fiber insulation are not in the interior of the ductwork.

PART 2 - PRODUCTS

A. Galvanized Steel Ducts: ASTM A653 having zinc coating in conformance with ASTM A90.

B. Steel Ducts: ASTM A569 and A568..

C. Flexible Ducts:
1. Manufacturers:
a. Anco Products Inc.
b. Hart & Cooley.
c. Tuttle & Bailey.
d. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.
2. UL Labeled, black polymer film supported by helically wound spring steel wire.
3. Pressure Rating: 4 inches WG positive and 0.5 inches WG negative.
4. Maximum Velocity: 4000 fpm.
5. Temperature Range: -20 degrees F to 175 degrees.

D. Insulated Flexible Ducts:
1. Manufacturers:
a. Anco Products Inc.
b. Hart & Cooley.
c. Tuttle & Bailey
d. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.
2. Black polymer film supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
3. Pressure Rating: 4 inches WG positive and 0.5 inches WG negative.
4. Maximum Velocity: 4000 fpm.
5. Temperature Range: -20 degrees F to 175 degrees F.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant:
1. Manufacturers:
a. Duro Dyne Corporation, Farmingdale, NY (800) 899-3876.
b. H.B. Fuller Co, St. Paul, MN (888) 423-8553.
c. Hardcast, Inc, Wylie, TX (800) 527-7092.
d. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.
2. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: ASTM A36; steel threaded both ends, threaded one end, or continuously threaded.

2.2 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:
1. Semco, Inc, Columbia, MO (888) 473-6264.
2. Metal-Fab, Inc, Wichita, KS (800) 835-2830.
3. United McGill Corp, Groveport, OH (614) 836-9981.
4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.3 DUCT ACCESS DOORS

A. Manufacturers:
1. Ductmate Industries, Inc, East Monongahela, PA (800) 245-3188.
2. Ruskin Manufacturing, Kansas City, MO (816) 761-7476.
3. Semco Inc, Columbia, MO (888) 473-6264.
4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
1. Less Than 12 Inches Square: Secure with sash locks.
2. Up to 18 Inches Square: Provide two hinges and two sash locks.
3. Up to 24 x 48 Inches: Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Provide an additional hinge.

D. Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
1. Ductmate Industries, Inc, East Monongahela, PA (800) 245-3188.
2. Ruskin Manufacturing, Kansas City, MO (816) 761-7476.
3. Semco Inc, Columbia, MO (888) 473-6264.
4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Connector: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30oz per sq yd.
   2. Net Fabric Width: Approximately 3 inches wide.
   3. Metal: 3 inches wide, 24 gage thick galvanized steel.

2.6 VOLUME CONTROL DAMPERS.

A. Manufacturers:
   1. Louvers and Dampers, Inc, Florence, KY (606) 647-2299.
   2. Prefco Products, Inc, Buckingham, PA (800) 437-6653.
   3. Ruskin Manufacturing, Kansas City, MO (816) 761-7476.
   4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Splitter Dampers:
   1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
   2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
   3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

D. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.7 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify that electric power is available and of the correct characteristics.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION - DUCTWORK

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

G. Use double nuts and lock washers on threaded rod supports.

H. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp and tape.

I. Connect flexible ducts to metal ducts with draw bands plus tape.

J. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.

K. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

L. Install so that unfaced fiberglass and mineral fiber insulation are not in the interior of the ductwork.

3.3 INSTALLATION - DUCTWORK ACCESSORIES

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

G. Use splitter dampers only where indicated.

H. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

3.4 CLEANING

A. Clean work under provisions of 017300.

B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal

materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Exposed-Surface Finish: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Greenheck Fan Corporation.
   2. Lloyd Industries, Inc.
   3. Nailor Industries Inc.
   4. Ruskin Company.
   5. SEMCO Incorporated.

B. Description: Gravity balanced.

C. Frame: 0.052-inch- thick, galvanized sheet steel.

D. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

E. Blade Action: Parallel.

F. Blade Seals: Neoprene, mechanically locked.

G. Blade Axles:
   1. Material: Stainless steel
   2. Diameter: 0.20 inch.

H. Tie Bars and Brackets: Galvanized steel.

I. Return Spring: Adjustable tension.

J. Bearings: Steel ball or synthetic pivot bushings.

K. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
      a. Sleeve Thickness: 20-gage minimum.
      b. Sleeve Length: 6 inches minimum.
   6. Screen Mounting: Rear mounted.

7. Screen Material: Aluminum.
8. Screen Type: Bird.
9. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Flexmaster U.S.A., Inc.
      b. McGill AirFlow LLC.
      c. METALAIRE, Inc.
      d. Nailor Industries Inc.
      e. Ruskin Company.

   2. Standard leakage rating, with linkage outside airstream.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch thick.
   6. Blade Axles: Stainless steel.
   7. Bearings:
      a. Molded synthetic.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:
   1. Size: 1-inch diameter.
   2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:
   1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
   2. Include center hole to suit damper operating-rod size.
   3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. McGill AirFlow LLC.
   2. METALAIRE, Inc.
   3. Nailor Industries Inc.
   4. Ruskin Company.

B. Frames:
   1. Hat or U shaped.
   2. Galvanized-steel channels, 0.064 inch thick.
   3. Mitered and welded corners.

C. Blades:
   1. Multiple blade with maximum blade width of 8 inches.
   2. Parallel- and opposed-blade design.
   3. Galvanized steel.
   4. 0.064 inch thick.
   5. Blade Edging: Closed-cell neoprene edging.

D. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
   1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:
   1. Molded synthetic.
   2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   3. Thrust bearings at each end of every blade.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. METALAIRE, Inc.
   4. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Ductmate Industries, Inc.
   2. Greenheck Fan Corporation.
   3. McGill AirFlow LLC.
   4. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision panel.
      d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   3. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
      d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Ventfabrics, Inc.
   4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd..
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd..
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

2.9 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.

C. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
   2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

N. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION

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SECTION 233416

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall exhausters.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

C. Related Sections:
   1. Section 230500 – Common Work results for HVAC: Basic mechanical methods.
   2. Section 233100 – HVAC Ducts and Casings: Connections to ductwork and backdraft dampers.
   3. Section 260500 – Common Work Results for Electrical: Electrical connections.

1.2 REFERENCES

A. Air Movement and Control Association (AMCA):
   1. AMCA 99 - Standards Handbook.
   2. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
   3. AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
   4. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
   5. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

B. National Electrical Manufacturers Association (NEMA):
   1. NEMA MG1 - Motors and Generators.

C. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories, Inc. (UL):
   1. UL 705 - Power Ventilators.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
   1. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.
   2. Assurance/Control Submittals:
      a. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
      b. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
   1. Operation and Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.

PART 2 - PRODUCTS

2.1 WALL EXHAUSTERS

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
   1. ACME Engineering & Manufacturing, Muskogee, OK (918) 682-7791.
   2. Greenheck Fan Corp., Schofield, WI (715) 359-6171.
   3. Penn Ventilator, Philadelphia, PA (215) 464-8900.
   4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Performance: Refer to schedule on Drawings.

C. Fan Unit: Direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch mesh, 16 gage aluminum bird screen.

D. Electrical Characteristics and Components.
   1. Electrical Characteristics: Refer to schedule on Drawings.
   2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
   3. Interlock with light switch.
   4. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted.

E. Backdraft Damper: Gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution Requirements: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure wall exhausters with stainless steel lag screws to [roof curb] structure.

C. Install flexible connections between fan inlet and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

E. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 233713

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Diffusers.
   2. Registers/grilles.
   3. Door grilles.

B. Related Sections:
   1. Section 099100 - Painting: Painting of ductwork visible behind outlets and inlets.

1.2 REFERENCES

A. Air Diffusion Council (ADC):
   1. ADC 1062 - Certification, Rating and Test Manual.

B. Air Movement and Control Association (AMCA):
   1. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. Air Conditioning and Refrigeration Institute (ARI):
   1. ARI 650 - Air Outlets and Inlets.

D. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
   1. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

F. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code.
   2. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

A. Section 013300 - Submittals: Procedures for submittals.
   1. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.4 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

C. Qualifications
   1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
   1. Titus, Richardson, TX (214) 899-1030.
   2. Ruskin, Kansas City, MO (816) 761-7476.
   3. Tuttle & Bailey, Holland, MI (800) 270-5686.

2.2 ROUND CEILING DIFFUSERS

A. Type: Round, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sectorizing baffles where indicated. Diffuser collar shall project not more than one inch above ceiling.

B. Fabrication: Steel with baked enamel, “off-white” finish.

C. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

D. Insulation: Back plate covered with glass fiber insulation with an aluminum foil vapor barrier to prevent harmful effects of condensation.

2.3 RECTANGULAR CEILING DIFFUSERS

A. Type: Square, stamped, multi-core diffuser to discharge air in four way pattern.

B. Frame: Surface mount, Snap-in, Inverted T-bar, or Spline type as scheduled on plans.

C. Fabrication: Steel or Aluminum with baked enamel, “off-white” finish.

D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

E. Insulation: Back plate covered with glass fiber insulation with an aluminum foil vapor barrier to prevent harmful effects of condensation.

2.4 PERFORATED FACE CEILING DIFFUSERS

A. Type: Perforated face with fully adjustable pattern and removable face.

B. Frame: Surface mount, Snap-in, Inverted T-bar, or Spline type as scheduled on plans.

C. Fabrication: Steel with steel or aluminum frame and baked enamel, “off-white” finish.

D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

E. Insulation: Back plate covered with glass fiber insulation with an aluminum foil vapor barrier to prevent harmful effects of condensation.

2.5 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical or horizontal face as scheduled on Drawings.

B. Frame: 1-1/4 inch margin with concealed mounting.

C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel, “off-white” finish.

D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

E. Insulation: Back plate covered with glass fiber insulation with an aluminum foil vapor barrier to prevent harmful effects of condensation.

2.6 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical or horizontal face, single or double deflection as scheduled on plans.

B. Frame: 1-1/4 inch margin with countersunk screw or concealed mounting and gasket.

C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel “off-white” finish.

D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

E. Insulation: Back plate covered with glass fiber insulation with an aluminum foil vapor barrier to prevent harmful effects of condensation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordinate location of outlets and inlets with Architectural reflected ceiling plan and make necessary adjustments in position to conform with architectural features, symmetry, and electrical lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 099100.

END OF SECTION

SECTION 235216

CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, condensing boilers, trim, and accessories for generating hot water.

B. Specification of Condensing Boilers requires that heating hot water system is able to operate at lower temperatures during significant operational hours to allow the unit(s) to go into condensing mode and provide the necessary efficiency improvements that will justify the additional first costs.

C. Boiler plants shall be sized to meet the heating load requirement of building as defined by computerized load calculations. Redundant boilers shall be avoided and the quantity should be limited to three or four maximum at the boiler plant. Loss of a single boiler should be able to still provide up to 65% of the peak heating load for typical USPS facilities. Plant redundancy is provided by the number of boilers and not excess capacity.

1.2 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

A. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Division 23 Section "Mechanical Vibration and Seismic Controls."

B. Operation and maintenance data.

C. Warranty: Special warranty specified in this Section.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.3 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Pulse-Combustion Boilers:

a. Heat Exchanger Damaged by Thermal Shock: 10 years from date of Substantial Completion.
b. Heat-Exchanger Corrosion: Prorated for five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Weil McLlain.

2.2 MANUFACTURED UNITS

A. Description: Factory-fabricated, -assembled, and -tested, pulse-combustion condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.

B. Heat Exchanger: Type 316L, stainless-steel primary and secondary combustion chamber.

C. Pressure Vessel: Carbon steel with welded heads and tube connections.

D. Exhaust Decoupler: Fiberglass composite material in a corrosion-resistant steel box.

E. Burner: Natural Gas gas, self-aspirating and self-venting after initial start.

F. Blower: Centrifugal fan to operate only during start of each burner sequence.

1. Motors: Comply with requirements specified in Division 23 Section "Motors."

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

I. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosure: NEMA 250, Type 1A.
3. Finish: Baked-enamel or powder-coated protective finish.
4. Insulation: Minimum 2-inch- (50-mm-) thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connection: Inlet duct collar and sheet metal closure over burner compartment.
6. Mounting base to secure boiler to concrete base.

J. Mufflers: Carbon-steel intake muffler and stainless-steel exhaust.

K. Condensate Trap: Cast-iron body with stainless-steel internal parts.

2.3 TRIM

A. All electrical components to be high quality manufacture and bear UL label.

B. Water boiler controls furnished:
1. High limit temperature control (190 degrees F maximum allowable boiler water temperature).
2. Combination pressure-temperature gauge. Gauge dial clearly marked and easy to read.
3. ASME certified pressure relief valve, set to relieve at 30 PSIG.
4. Flue gas, outlet water temperature, and return water temperature sensors.
5. Low water protection with manual reset.
6. Built-in freeze protection.
7. Circulation pump: Non-overloading, inline pump with split capacitor motor having thermal-overload protection and lubricated bearings, design to operate at specified boiler pressures and temperatures.
8. Main pipe header manifold kit.

2.4 CONTROLS

A. Refer to specification Section 250504 Building Automation System (BAS) General."

B. Boiler operating controls shall include the following devices and features:

1. Built-in MODBUS communication
2. Circulator contacts
3. Auxiliary input/output capability.
4. Variable temperature zones that require no mixing valves.
5. Thermostat inputs.
6. Outdoor reset for each priority.
7. Zone and priority-based setup options.
8. Network and local priorities available on each cascaded boiler.
9. Flue gas, outlet water temperature, and return water temperature sensors.
10. LCD display and 5 button interface.
11. Alarm contact that triggers during manual lockout, flame failure, high temperature limit and low water cut-off.
12. Remote modulation capable of interfacing with Building Automation System and multiple boiler systems.
13. Ability to control additional heat demand.
14. Set-Point Adjust: Set points shall be adjustable.
15. Sequence of Operation: Refer to Section 230905 – Sequence of Operation for coordination.

a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms. Refer to specification Section 250504 Building Automation System (BAS) General.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
4. Provide each motor with overcurrent protection.

2.6 VENTING

A. Combustion Vent: Complete system, Sch 40 PVC piping pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, Sch 40 PVC, pipe, vent terminal with screen, inlet air coupling, and sealant.

C. Concentric Vent/Air Termination Kit: Sch 40 PVC.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work for HVAC," and concrete materials and installation requirements are specified in Division 3.

B. Vibration Isolation: Elastomeric isolation pads with a minimum static deflection of 0.25 inch (6.35 mm).

C. Install gas-fired boilers according to NFPA 54.

D. Assemble and install boiler trim.

E. Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 22 Section "Common Work for Plumbing."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting:

1. Install flue venting kit and combustion-air intake.

I. Ground equipment according to Division 26 Section "Grounding and Bonding."

J. Connect wiring according to Division 26 Section "Conductors and Cables."

K. Stack drain piping shall be routed through an acid neutralizing tank to prevent damage to piping, floors and floor drains and to prevent highly acidic waste from entering the sanitary drain system.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Remove and replace malfunctioning units and retest as specified above.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

SECTION 238100

DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Packaged Rooftop Air Conditioning Unit (RTU)
   2. Temperature Controls

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

C. Related Sections:
   1. Section 077213 – Manufactured Curbs
   2. Section 283100 – Fire Detection and Alarm
   3. Section 233100 – HVAC Ducts and Casings
   4. Section 230904 - Instrumentation and Control for HVAC (MSBD)
   5. Section 260519 – Low-Voltage Electrical Power Conductors and Cables

1.2 REFERENCES

A. ANSI/AHRI 210/240-2008 – “Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment”

B. U.S. EPA Final Rule 21 (40 CFR Part 82 – 81 FR 86778)

C. NFPA 70 - National Electrical Code

D. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

E. UL 465 - Central Cooling Air Conditioners

1.3 DEFINITIONS

A. Roof Top Air Conditioning Unit (RTU): Single-packaged, self-contained, factory-assembled, pre-wired, Door unit consisting of cabinet and frame, evaporator fan, evaporator-coil, fuel-fired furnace, condenser coil, condenser fan, compressor(s), controls and filters in draw-through air flow configuration.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
   1. Product Data: Provide product data for manufactured Units. Indicate performance capacities, energy-efficiency ratings and electrical characteristics.
   2. Shop Drawings: Provide shop drawings for manufactured Units. Indicate refrigerant pipe connections, ductwork connections, filter size and quantity, condensate drain connection, thermostatic valves, temperature controls connections and electrical rough-in connections with electrical characteristics and connection requirements.

3. Assurance/Control Submittals:
    a. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
    b. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
1. Project Record Documents: Accurately record the following:
    a. Plan view of installed location of Units
    b. Elevation or section view of installed Units.
2. Warranty: Submit written minimum five (5) years warranty to include coverage for refrigeration compressors condenser and evaporator with forms completed in United States Postal Service name and registered with manufacturer as specified in this Section.
3. Extra Products: Submit extra products as specified in this Section.
4. Operating instruction: Document training by furnishing a sign-in sheet with a description of the training provided instructors name and organization, and those who received training. Refer to 017704 1.3, 1.4, and 1.5 for more specific training

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer: Company specializing in manufacturing Products specified with minimum five (5) years documented experience.
2. Installer: Company specializing in performing the Work of this Section with minimum five (5) years documented experience.

B. Regulatory Requirements:
1. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.
2. ASHRAE Standard 15-2016 for safety codes for mechanical refrigeration.
3. ASHRAE Standard 34-2016 for safety classifications of refrigerants based on toxicity and flammability data.
4. ASHRAE Standard 147-2013 for refrigerant leaks, recovery, and handling and storage requirements.
5. Comply with U.S. EPA Final Rule 21 (40 CFR Part 82 – 81 FR 86778) for acceptability status of substitute refrigerants.
6. Comply with any state, fire marshal, building code or other local authority prohibitions or regulations related to flammable refrigerants.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
1. Trane 1-972-406-3656

B. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Not Permitted.

2.2 MATERIALS

A. Cabinet -
   1. Frame and Panels: Minimum 18 gauge galvanized steel structural frame members, minimum 20 gauge cabinet panels with baked enamel or powder coated finish, easily removed access doors or panels with quick release fasteners.
   2. Provide with hail guards to protect condenser coils in hail prone locations.
   3. Insulation: Minimum one half (1/2") inch (13 mm) thick acoustic duct liner with smooth, black neoprene air-side surface for lining cabinet interior. Edges exposed to conditioned air path shall be coated with black neoprene surface.
   4. Drain Pan: [Galvanized steel with corrosion-resistant coating][Stainless steel], insulated, high-slope for positive drainage per ASHRAE Standard 62-89. Drain pan shall extend under the complete coil section.

B. Evaporator Fan –
   1. Direct drive plenum fan with backward-cured fan wheel along with an external rotor direct drive variable speed indoor motor. Variable speed adjustment potentiometer located in the unit control box.

C. Evaporator Coil -
   1. Direct expansion cooling coil shall be 5/16- inch outside diameter , thick seamless copper tubes expanded into aluminum fins. Maximum coil face velocity shall not exceed five hundred feet per minute.
   2. Refrigeration circuit with externally equalized thermal expansion valve, filter-drier, and charging valves.

D. Heater -
   1. Fuel Fired Furnace: natural-gas, self-contained, package unit complete with burner and controls. Aluminized steel heat exchanger, AGA certified, minimum AFUE efficiency of 75 percent. Electronic pilot ignition shall be provided. Unit shall be provided as an integral part of the Roof Top Air Conditioning Unit.

E. Air Filters – MERV 8.

F. Condenser Fans - Direct-driven, with permanently lubricated bearings, thermal overload protection, weatherproofed, vertical discharge propeller type with fan guard, statically and dynamically balanced, resiliently mounted.

G. Condenser Coil - Shall be be 5/16- inch outside diameter , thick seamless copper tubes expanded into aluminum fins with sub-cooling circuits, tested for leaks up to 425 psig. Suction and Liquid line service gauge ports and full charge of refrigerant. Provide refrigerant pressure switches to cycle condenser fans. Coil coating shall be one of the following:
   1. Surface treatment on aluminum fin on copper tubing or solid aluminium micro channel coils shall have a factory dipped process flexible epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins or channels. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.8 – 1.2 mil on all surface areas including fin edges. Superior hardness characteristics of 2H per ASTM D3363-92A and a cross-hatch adhesion of 4B-5B per ASTM B3359-93. Impact resistance shall be up to 160 in/lb per ASTM D2794-93. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117-97. Coating can be field applied for smaller equipment to prevent delays during construction.
   2. Surface treatment shall be ambient air temperature cured, inorganic film structures and shall not act as an insulating barrier to the substrate, which would inhibit or degrade heat transfer coefficients or increase energy consumption of the condenser. The dry film thickness shall be no greater than 8 microns. Pass ASTM G-21, with a zero (0) microbial spore growth development rating. The standard ASTM G-21 test must have been conducted by an accredited, third party,

independent laboratory. Surface treatment shall meet or exceed 6,000 hours of corrosion protection using ASTM B117 testing protocols and conducted by an accredited, third party, independent laboratory.

H. Compressor - Shall be hermetically sealed, 3600 rpm maximum, resiliently mounted with positive lubrication internal motor protection, refrigerant line filter drier, and crankcase heater..

I. Refrigerant – Only R-134A or R-410A refrigerant is permitted.
   1. Note: As of this update, EPA has not designated a schedule for phase out of R-134A or R-410A in RTUs. System must comply with U.S. EPA's Significant New Alternatives Policy (SNAP) program for acceptable substitute refrigerants. If/when EPA deems R-134A and R-410A unacceptable, new generation equipment utilizing lower Global Warming Potential (GWP) hydrofluoroolefin (HFO) refrigerants and blends should be considered.
   2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

J. Controls:
   1. Native BACnet controller with room temperature sensor/control. Space sensors shall be located in the spaces served and shall be provided with a tamper proof covers.
   2. Equipment Manufacturer shall furnish and install a direct digital control (DDC) and building automation system (BAS) controller as specified in Sections 230905, 250504, and 253104. The controller shall utilize electronic sensing and microprocessor-based digital control to perform the functions specified. The BAS and digital control and communications components installed shall be an integrated distributed processing system utilizing BACnet communication requirements as defined by ASHRAE/ANSI 135-2004 for all communication. System components shall communicate using native BACnet in accordance with the Standard and all current addenda and annexes, including all building controllers and application specific controllers. Gateways to other communication protocols are not acceptable. The following requirements apply:
      a. BACnet Building Controller Requirements:
         i. The BC(s) shall support all BIBBs defined in the BACnet Building Controller (B-BC) device profile as defined in the BACnet standard.
         ii. BCs shall communicate over the BACnet Building Controller LAN.
         iii. Each BC shall be connected to the BACnet Building Controller LAN communicating to/from other BCs.
      b. BACnet AAC(s) and ASC(s) Requirements:
         1. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.
         2. AAC(s) and ASC(s) shall communicate over the BACnet Building Controller LAN or the ASC LAN or sub-LAN.
   3. Each AAC(s) and ASC(s) shall be connected to the BACnet Building Controller communicating to/from other BCs over a BACnet Building Controller LAN
      a. Sequence of operation is specified in Section 230905.

K. 3-Phase rooftop air conditioning equipment shall be provided with a Voltage Phase Monitor. Phase monitor shall provide 100% protection for motors and compressors against problems caused by phase loss, phase imbalance, and phase reversal. Phase monitor is equipped with an LED that provides an ON or FAULT indicator.

L. Convenience Outlet: Provide one weather-proof 120-volt GFI convenience outlet mounted to the exterior of each unit.

M. Mixed-Air Casing:
   1. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fail to closed position. Relief dampers may be gravity balanced.
   2. Gaskets: Provide tight fitting dampers with edge gaskets maximum leakage 5 percent at 2 inches (500 Pa) pressure differential.
   3. Damper Operator: 24 volt with gear train sealed in oil with spring return to fail to closed position.

N. See Structural Drawings for Equipment Support - Supports to be supplied and installed by General Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

C. Verify that proper power supply is available.

D. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

E. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION

A. Mount RTU(s) on roof structural steel supports providing water-tight enclosure to protect ductwork, utility services, and building envelope.

B. Install RTU(s) level and in accordance with manufacturer’s instructions.

C. Install condensate drain pipes from Unit drain pan to designated location shown on drawings. Provide minimum 1/8 inch per foot slope on all horizontal pipes.

D. Mechanical equipment, appliances, and supports that are exposed to wind shall be designed and installed to resist the wind pressures determined in accordance with the local Building Code.

E. For High-Velocity Hurricane Zones, all rooftop equipment and supports shall be secured to the structure in compliance with the loading requirements of the local Building Code.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field testing and inspection.
B. Operating Instruction
   1. Provide on-site instruction to review the operation of the system and detail any common troubleshooting or maintenance that is required to ensure normal operation.
   2. Provide one complete set of equipment operating, installation, and programming manuals that will remain at the installed location.

END OF SECTION

SECTION 238126

SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Air Handling Unit.
2. Condensing Heat Pump Unit with Auxiliary Electric Heat.
3. Refrigerant piping.
4. Temperature Controls.
5. Refrigeration.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

1.2 DEFINITIONS

A. Air Handling/Furnace Unit: Packaged, self-contained, factory-assembled, pre-wired, indoor unit consisting of cabinet, evaporator fan, evaporator-coil, heater, controls and filters.

B. Condensing Unit: Packaged, self-contained, factory-assembled, pre-wired outdoor unit consisting of cabinet, condenser coil, condenser fan, compressor and controls.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
1. Product Data: Provide for Air Handling Units and Condensing Units. Indicate performance capacities, energy-efficiency ratings, and electrical characteristics.
2. Shop Drawings: Provide for Air Handling Units and Condensing Units. Indicate refrigerant pipe connections, ductwork connections, filter size and quantity, condensate drain connection, thermostatic valves, temperature controls connections and electrical rough-in connections with electrical characteristics and connection requirements.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
1. Project Record Documents: Accurately record the following:
a. Plan view of installed location for Air Handling Units and Condensing Units.
b. Elevation or section view of installed Air Handling Units and Condensing Units.
2. Special Warranty: Submit written special warranty with forms completed in United States Postal Service name and registered with manufacturer as specified in this Section.
3. Extra Products: Submit extra products as specified in this Section.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer: Company specializing in manufacturing Products specified with minimum five years documented experience.

2. Installer: Company specializing in performing the Work of this Section with minimum five years documented experience.

B. Regulatory Requirements:
1. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.
2. ASHRAE Standard 15-2016 for safety codes for mechanical refrigeration.
3. ASHRAE Standard 34-2016 for safety classifications of refrigerants based on toxicity and flammability data.
4. ASHRAE Standard 147-2013 for refrigerant leaks, recovery, and handling and storage requirements.
5. Comply with U.S. EPA Final Rule 21 (40 CFR Part 82 – 81 FR 86778) for acceptability status of substitute refrigerants.
6. Comply with any state, fire marshal, building code or other local authority prohibitions or regulations related to flammable refrigerants.

1.5 WARRANTY

A. Section 017704 - Closeout Procedures and Training.

B. Special Warranty:
1. Split-system units including refrigeration compressors.
2. Warranty Period: 5 years labor and materials on air conditioning unit compressors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
1. Trane.

B. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.2 AIR HANDLING UNITS

A. Unit Model: Indicated on Drawings.

B. Cabinet:
1. Frame and Panels: Minimum 22 gauge galvanized steel with baked enamel finish, easily removed access doors or panels with quick fasteners.
2. Insulation: Minimum one half 1/2 inch thick acoustic duct liner with smooth, black neoprene air-side surface for lining cabinet interior.
3. Drain Pan: Galvanized steel with corrosion-resistant coating, insulated, high-slope for positive drainage per ASHRAE Standard 62-89. Drain pan shall extend under the complete coil section.

C. Evaporator Fan:
1. Belt Drive, Double width, Forward Cured, Centrifugal Type Fan with variable speed motor.
2. Motors: See equipment schedule

D. Evaporator Coil:

1. 3/8” internally enahanced copper tube mechanically bonded to lanced aluminum plate fins, factory pressure and leak tested to 449 psig.
2. Refrigeration circuit with externally equalized thermal expansion valve, filter-drier, and charging valves.

E. Heater:
1. Heat Pump: Condensing unit with refrigerant cycle reversing valve with auxiliary heater.
   a. Auxiliary Electric-Resistance Heater: Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings, with automatic reset thermal cut-out, built-in magnetic contactors, manual reset thermal cut-out, airflow proving device, load fuses.

F. Air Filters: Easily removed 2 inch thick throw-away, MERV 8. Maximum filter face velocity shall not exceed 500 feet per minute.

G. Controls:

1. Factory wired, unit mounted terminal board and include 24 Volts control circuit transformer.
2. Controls – certified BacNet output directly from AHU to thermostats, sensors and other controllers, and to Building Automation System.
3. Low Ambient Controller: Cycles condenser fan to permit operation down to low temperature observed in project location.
4. 3-Phase air conditioning equipment shall be provided with a Voltage Phase Monitor. Phase monitor shall provide 100% protection for motors and compressors against problems caused by phase loss, phase imbalance, and phase reversal. Phase monitor is equipped with an LED that provides an ON or FAULT indicator.
5. Sequence of Operation is specified in Section 230905.

H. Duct furnaces shall generally meet the specified requirements for electric and fuel fired furnace heaters.

2.3 CONDENSING HEAT PUMP UNIT

A. Unit Model: Indicated on Drawings.

B. Cabinet: Minimum 14 gauge galvanized steel welded frame with minimum 16 gauge galvanized steel panels and access doors with weather resistant, phosphatized finish.

C. Condenser Fans: Direct-driven, with permanently lubricated bearings, thermal overload protection, weatherproofed, vertical discharge propeller type with fan guard, statically and dynamically balanced, resiliently mounted.

D. Condenser Coil: 1/2 inch outside diameter , 0.016 inch thick seamless copper tubes expanded into aluminum fins with sub-cooling circuits, tested for leaks up to 425 psig. Suction and Liquid line service gauge ports and full charge of refrigerant.

E. Compressor: Hermetically sealed, 3600 rpm maximum, resiliently mounted with positive lubrication internal motor protection and crankcase heater. Minimum EER 10.
1. Reversing valve for heat-pump units.

F. Controls - Shall be factory wired and shall include contactors, high and low pressure cutouts, internal winding thermostat, 24 Volts control circuit transformer, non-cycling reset relay. Provide lockable disconnect switch at each new air handling unit/condensing unit. Provide low ambient controller to cycles condenser fan(s) to permit operation down to project area low temperature.

2.4 REFRIGERANT PIPING

A. Per section 232300.

2.5 TEMPERATURE CONTROLS

A. Per section [230904] or [230905]. For twinned furnace applications, install controls to stage burners and condensing units as required for proper heating and cooling. Blower units shall operate together.

2.6 REFRIGERATION

A. Only-R-407C and R-410A refrigerant is permitted.
   1. Note: As of this update, EPA has not designated a schedule for phase out of R-407C or R-410A in air conditioners. System must comply with U.S. EPA's Significant New Alternatives Policy (SNAP) program for acceptable substitute refrigerants. If/when EPA deems R-407C and R-410A unacceptable and as that deadline approaches, new generation equipment utilizing lower Global Warming Potential (GWP) hydrofluoroolefin (HFO) refrigerants and blends should be considered.
   2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install refrigerant lines from Air Handling Unit Coil to Condensing Unit in accordance with manufacturer's recommendations. Insulate new suction piping in accordance with manufacturer's recommendations.

C. Install condensate drain pipes from Air Handling Unit drain pan to designated location shown on drawings. Provide minimum 1/8 inch per foot slope on all horizontal pipes.

D. On units over 2000 CFM capacity, provide smoke detector in retun air ductwork to shut down unit upon sensing smoke.

E. Connect units to electrical system. Provide fused disconnects. Connect to temperature control system. Test for proper operation. Where units are twinned, install controls to operate blowers together and stage burners and condensing units on demand.

F. Connect air handling supply and return to ductwork using flexible connectors. Install smoke detector in return airstream to deactivate fan on sensing smoke.

G. Mechanical equipment, appliances, and supports that are exposed to wind shall be designed and installed to resist the wind pressures determined in accordance with the local Building Code.

H. For High-Velocity Hurricane Zones, all rooftop equipment and supports shall be secured to the structure in compliance with the loading requirements of the local Building Code.

END OF SECTION

SECTION 238239

UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cabinet unit heaters with centrifugal fans and hot-water coils.
   2. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Plans, elevations, sections, and details.
   2. Location and size of each field connection.
   3. Equipment schedules to include rated capacities, furnished specialties, and accessories.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Carrier Corporation.
   2. International Environmental Corporation.
   3. McQuay International.
   4. Trane.

B. Description: A factory-assembled and -tested unit complying with ARI 440.

C. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
   1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch-thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

2. Recessing Flanges: Steel, finished to match cabinet.
3. Control Access Door: Key operated.
4. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, <Insert dimension> high with leveling bolts.

D. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated: 90 percent arrestance and 7 MERV.

E. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

F. Fan and Motor Board: Removable.
1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

G. Factory, Hot-Water Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet and outlet.
1. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
a. Minimum Diameter: Equal to cabinet unit heater connection size.
2. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
3. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
4. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 threaded pipe and full-port ball valve in strainer drain connection.
5. Wrought-Copper Unions: ASME B16.22.

H. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
1. Manual fan speed switch.
2. Adjustable deadband.
3. Concealed set point.
4. Deg F indication.
5. Unit-mounted temperature sensor.
6. Unoccupied period override push button.
7. Data entry and access port.
a. Input data includes room temperature, and occupied and unoccupied periods.
b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

I. Electrical Connection: Factory wire motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit heaters to comply with NFPA 90A.

B. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater.

E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

F. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

G. Install piping adjacent to machine to allow service and maintenance.

H. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

I. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

J. Comply with safety requirements in UL 1995.

K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 250504

BUILDING AUTOMATION SYSTEM (BAS) GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
1. General Requirements
2. Description of Work
3. Quality Assurance
4. System Architecture
5. Distributed Processing Units/Quantity and Location
6. Demolition and Reuse of Existing Materials and Equipment
7. Sequence of Work

B. Related documents
1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
2. Section 260500 – Common Work Results for Electrical
3. Section 260533 – Raceway and Boxes for Electrical Systems
4. Section 265100 – Interior Lighting
5. Section 265600 – Exterior Lighting
6. Section 260623 – Lighting Control Devices
7. Section 270500 – Common Work Results for Communications
8. Section 230500 – Common Work Results for HVAC
9. Section 251304 – Facility System Integration Into EEMS
10. Section 251304a – EEMS Integration Worksheet
11. Section 250804 – Building Automation System (BAS) Commissioning

1.2 DESCRIPTION OF WORK

A. The Direct Digital Control (DDC) and Building Automation System (BAS) defined in this specification shall interface with the USPS EEMS Network, and shall utilize the BACnet communication requirements as defined by ASHRAE/ANSI 135-2004 for all communication. Towards this end, contractor shall provide a router/gateway(s) as necessary to facilitate all specified objects and services and have them configured/mapped as applicable.

B. Contractor shall furnish and install a Direct Digital Control and Building Automation System. The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified. The BAS for this project will generally consist of monitoring and control of systems listed below. Reference control drawings, sequences of operation, and points lists.

C. The systems to be controlled under work of this section basically comprise: Decommission and remove the entire existing HVAC system for a complete replacement. The hydronic system includes air-cooled chiller, boiler, compressor, pumps, valves, fittings, expansion tanks, air separators, pneumatic controls, and all accessible piping and insulation. Other equipment includes three chilled water air handling units, finned-tube radiators, cabinet unit heaters, exhaust fans, ductwork, insulation, air terminal devices, and controls. The new HVAC system is inclusive of but not limited to:
1. Two packaged rooftop units with DX cooling, hot-gas reheat, gas-fired furnace, and economizer mode of operation.

2. One split system heat pump with supplemental electric heat and economizer mode of operation.
3. New modular boiler plant for perimeter heating. The hot water system will serve new finned-tube radiators and cabinet unit heaters throughout the facility.
4. New exhaust fans.
5. Connect new HVAC to DDC control system and EEMS.
6. Provide new ductwork, insulation, and airduct accessories to accommodate the new system.
7. Provide new air terminal devices.
8. Provide new hydronic piping, insulation, and piping accessories.

D. The HVAC systems being controlled are: Two packaged rooftop units with DX cooling, hot-gas reheat, gas-fired furnace, and economizer mode of operation. One split system heat pump with supplemental electric heat and economizer mode of operation. New modular boiler plant for perimeter heating. The hot water system will serve new finned-tube radiators and cabinet unit heaters throughout the facility.

E. This Section and related sections defines the manner and method by which these controls function.

1.3 APPLICATION OF OPEN PROTOCOLS

A. Subject to the detailed requirements provided throughout the specifications, the BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system utilizing BACnet. System components shall communicate using native BACnet in accordance with ASHRAE Standard 135 and current addenda and annexes, including all workstations, all building controllers, and all application specific controllers. Gateways to other communication protocols are not an acceptable solution and should only be used when communicating with a device or piece of equipment not provided by this contractor and/or only when directed by the Contracting officer.

1.4 QUALITY ASSURANCE

A. Reserved

B. All products used in this project shall be a current product under manufacture. Spare parts are to be available for a period of at least five years after project commissioning. The vendor shall have a stated policy of maintaining backward compatibility with previous versions of its product.

C. Product Line Demonstrated History: The product line being proposed for the project must have an installed history of demonstrated satisfactory operation for a length of 2 years since date of final completion in at least 10 installations of comparative size and complexity. Submittals shall document this requirement with references.

D. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years. Firms with experience in DDC installation projects with point counts equal to this project and systems of the same character as this project. If installer is a Value Added Reseller (VAR) of a manufacturer’s product, installer must demonstrate at least three years prior experience with that manufacturer’s products. Experience starts with awarded Final Completion of previous projects. Submittals must document this experience with references.

E. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than one year from date of final completion on at least 3 projects of similar size and complexity. Submittals shall document this experience with references.

F. Installer's Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than 5 years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than 2 projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one alternate for each duty. Submittals shall document this experience with references. The proposed individuals must show proof of the following training:
   1. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration
   2. Programming Training: Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.

G. Installer's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5 year history of servicing installations of similar size and complexity. Installer must also document at least a one year history of servicing the proposed product line.

H. Installer's Response Time and Proximity

I. Installer must maintain a fully capable service facility within an 80 mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
   1. Emergency response time should be within an hour. Installer must demonstrate the ability to meet the response times.

1.5 CODES AND STANDARDS

A. The following codes and standard intended to apply as applicable as not all will apply to all installations

B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
   1. ASHRAE 135-2004 and all addenda: BACnet - A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 2004 including all Addendums.

C. Electronics Industries Alliance
   1. EIA-709.1-A-99: Control Network Protocol Specification
   2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
   3. EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
   4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
   5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
   6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
   7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
   8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
   9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications

D. Underwriters Laboratories
   1. UL 916: Energy Management Systems.

E. NEMA Compliance
   1. NEMA 250: Enclosure for Electrical Equipment
   2. NEMA ICS 1: General Standards for Industrial Controls.

F. NFPA Compliance
   1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
   2. NFPA 70 National Electrical Code (NEC)

G. Institute of Electrical and Electronics Engineers (IEEE)
   1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
   2. IEEE 802.3: CSMA/CD (Ethernet – Based) LAN
   3. IEEE 802.4: Token Bus Working Group (ARCNET – Based) LAN

1.6 DEFINITIONS

A. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application-specific applications.

B. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).

C. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications. .

D. BACnet/BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135-2004.

E. BACnet Interoperability Building Blocks (BIBB): A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.

F. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended opr required destinations.

G. Building Automation System (BAS): The entire integrated management and control system.

H. Building Controller (BC): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems, acting as a communications router between the LAN backbone and sub-LANs, and data storage for trend information, time schedules, and alarm data.

I. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135-2004).

J. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.

K. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).

L. Controller or Control Unit (CU): Intelligent stand-alone control panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.

M. Control Systems Server (CSS): This shall be a computer (or computers) that maintains the system's configuration and programming database. This may double as an operator workstation.

N. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic.

O. Enterprise Energy Management System (EEMS): The USPS Enterprise Energy management System is an existing Ethernet/Internet-based network based system connecting multiple facilities with a central data warehouse and server and, accessible via standard web-browser and Terminal Services.

P. Functional Profile: A collection of variables required to define the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.

Q. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them (ASHRAE/ANSI 135-2004).

R. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.

S. IT LAN: Reference to the facility's Information Technology network, used for normal business-related e-mail and Internet communication.

T. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS

U. Local Area Network (LAN): General term for a network segment within the architecture. Various types and functions of LANs are defined herein.

V. Local Supervisory LAN: Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs, CSSs and EEMS if specified. See System Architecture below. CAN BE THE PRIMARY CONTROLLING LAN.

W. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard. (ASHRAE/ANSI 135-2004).

X. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.

Y. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.

Z. Operator Workstation (OWS): The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.

AA. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.

BB. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.

CC. Protocol Implementation Conformance Statement (PICS): A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device (ASHRAE/ANSI 135-2004).

DD. Primary Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.

EE. Router: A device that connects two or more networks at the network layer.

FF. Secondary Controlling LAN: LAN connecting AACs and ASCs, generally lower speed and less reliable than the Primary Controlling LAN. Refer to System Architecture below.

GG. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.

HH. SQL: Standardized Query Language, a standardized means for requesting information from a database.

II. XML (Extensible Markup Language): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.7 FUNCTIONAL INTENT AND PRODUCT SUBSTITUTIONS

A. Throughout Sections 250504 through 251404, the BAS Sequences of Operation (Section 259004), and BAS System Commissioning (Section 250804) detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent. Contractors shall be allowed to propose product substitutions without prior approval. The successful Supplier will be required to demonstrate that proposed products meet all specification requirements through the shop drawing submittal process. If they are unable to demonstrate that their product meets these requirements, then Supplier will be required to furnish an alternative product from one of the approved manufacturers.

B. Refer to Section 016000 for substitution procedures.

1.8 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows.
   1. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD 2004 or later version drawing file and/or Adobe Portable Document Format file. All ‘x reference’ and font files must be provided with AutoCAD files.
   2. Other Submittals: All other submittals shall be provided in Adobe Portable Document Format

C. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above.

D. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.

E. Shop Drawings: Submit shop drawings for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Each shop drawing shall contain the following information:
   1. System Architecture and System Layout:
      a. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, address, device instance, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.
      b. Provide floor plans locating all control units, workstations, servers, LAN interface devices, gateways, etc. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, address, device instance, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be

located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.

2. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include verbal description of sequence of operation.
3. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
4. On each schematic, provide a point summary table listing building number and abbreviation, Ethernet backbone network number, network number, device ID, full point name, point description, , object ID (object type, instance number). See Section 251404 - Part III for additional requirements.
5. Provide as a separate table a listing of each BACnet object to include Device ID, object ID description, alarm value, for each I/O, virtual and calculated point
6. Label each control device with setting or adjustable range of control.
7. Label each input and output with the appropriate range.
8. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
9. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers.
10. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring, which are existing, factory-installed and portions to be field-installed.
11. Sheets shall be consecutively numbered.
12. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.
13. Table of Contents listing sheet titles and sheet numbers.
14. Legend and list of abbreviations.
15. Memory allocation projections.
16. Submit along with shop drawings but under separate cover calculated and guaranteed system response times of the most heavily loaded LAN in the system.

F. Open Protocol Information
   1. BACnet Systems:
      a. BACnet object description, object ID, and device ID, for each I/O point.
      b. Documentation for any non-standard BACnet objects, properties, or enumerations used detailing their structure, data types, and any associated lists of enumerated values.
      c. Submit PICS indicating the BACnet functionality and configuration of each controller.

G. Framed Control Drawings: Laminated control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel.

H. Control Logic Documentation
   1. Submit control logic program listings (for graphical programming) and logic flow charts illustrating (for line type programs) to document the control software of all control units.
   2. Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
   3. Include written description of each control sequence.

4. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
5. Sheets shall be consecutively numbered.
6. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
7. Include Table of Contents listing sheet titles and sheet numbers
8. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Section 017704.

I. Operation and Maintenance Materials:
1. Submit documents under provisions of Section 013300. One copy of the materials shall be delivered directly to the USPS facilities operation staff, in addition to the copies required by other Sections.
2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
3. Submit BAS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
4. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.
5. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.
6. Submit listing required preventative and predictive maintenance tasks required for all equipment furnished, network and system health monitoring and activities. For each item listed, provide specific task instructions, acceptance criteria and recommended task frequency.
7. Submit schedule of planned maintenance tasks to be completed by the vendor during the warranty period specified below.

J. Controls contractor shall provide to the USPS with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches. This service will be provided for 5 years as part of the contract price, and will be offered to the USPS thereafter for the same price as to a dealer or branch.

K. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.

L. Product Warranty Certificates: submit manufacturers product warranty certificates covering the hardware provided.

1.9 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 013300.

B. Record copies of product data and control shop drawings updated to reflect the final installed condition.

C. Record copies of approved control logic programming and database on paper and on CD's. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.

D. Record copies of approved project specific graphic software on CDs.

E. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, MAC address and drawing reference number.

F. Provide record riser diagram showing the location of all controllers.

G. Maintain project record documents throughout the warranty period and submit final documents at the end of the warranty period

1.10 SYSTEM ARCHITECTURE

A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. The Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.

B. The system shall be configured as a distributed processing network(s) capable of expansion as specified below.

C. The system architecture shall consist of an Ethernet-based, wide area network (WAN), a single Local Area Network (LAN) or multi-leveled LANs that support BCs, AACs, ASCs, Operator Workstations (OWS), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the BAS structure.
   1. EEMS LAN: Internet-based network connecting multiple facilities with a central data warehouse and then EEMS server. This is an existing infrastructure and contractor is not required to configure any components of this EEMS. Contractor is however required to provide BACnet Objects and services at the Local Supervisory LAN via BACnet over IP. Refer to Section 251404 for requirements.
   2. Local Supervisory LAN: The Local Supervisory LAN shall be an Ethernet-based, 100 Mbps LAN connecting Primary Control LANs and OWSs. The LAN serves as the inter-BC communications path and OWS-to-BC gateway and communications path. Refer to section 251404 coordination requirements with USPS. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 5 cable with switches and routers that support 100 Mbps throughput. Power-line carrier communication shall not be acceptable for communications. The higher level layers of this network shall be BACnet as described below:
      a. BACnet Supervisory LAN: BACnet/IP as defined in Addendum A (Annex J) of the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in BACnet. Point/Object naming conventions are specified in 251404 - Part III.
   3. Primary Controller LAN (‘Primary LAN’): High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs and Building Controllers (BCs) and communicate exclusively control information. Acceptable technologies include:
      a. Ethernet (IEEE802.3)
      b. ARCNET (IEEE802.4)
   4. Secondary Controller LAN (‘Secondary LAN’): Network used to connect AACs or ASCs to BC. These can be Master Slave/ Token Passing or polling, in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements.

D. Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely.

E. Remote Data Access: The system shall support the following methods of remote access to the building data.
   1. Dial-in via minimum of a 56k modem. Dial-in connection shall allow access to all control system facilities and graphics with appropriate password. The USPS shall provide and pay for the digital grade voice line to support this remote connection.
   2. DSL/Broadband/Fiber. All workstations shall be equipped with standard 100 megabit Ethernet cards; the USPS at its option may elect to use DSL or other broadband service to access the system.

3. Browser-based access: A remote user using a standard browser shall be able access all control system facilities and graphics with proper password. USPS shall secure and be responsible for the continuous Internet connection. The following paradigms are acceptable for browser-based access:
    a. Native Internet-based user interfaces (HTML, Java, XML, etc.) that do not require a plug-in.
    b. User interfaces that via a standard browser use a freely distributed and automatically downloaded and installed plug-in or 'thick' client that presents the user interface across the web.

F. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Contractor shall submit guaranteed response times with shop drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall reconfigure LAN as necessary to accomplish these performance requirements. Generally requirements do not apply when a remote connection must be established via modem:
1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
2. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
3. 20 seconds between and a Level 3-5 alarm occurrence and enunciation at operator workstation.
4. 10 seconds between an operator command via the operator interface to change a setpoint and the subsequent change in the controller.
5. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.
6. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least 10 points.

G. Control Systems Server (CSS): This shall be a computer (or computers) that maintain the systems configuration and programming database. This will double as an operator workstation. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It shall also act as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information. Refer to Section 251404 - BAS Field Panels for its requirements.

H. The Operator Work Station (OWS) interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. Refer to Section 251404 – BAS Field Panels.

I. The BCs, AACs, ASCs, shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices as more fully specified in Section 251404 - BAS Field Panels..

J. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on a server or workstation on the Local Supervisory LAN. User tools provided to the USPS shall allow configuring, updating, maintaining, etc. current configurations and settings whether they are initiated at the server or the end device. Database Schema shall be published and provided to the USPS to facilitate easy access to the data.

K. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted.

L. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

M. Anytime any controller's database or program is changed in the field, the controller shall be capable of automatically uploading the new data to the CSS.

1.11 WARRANTY MAINTENANCE

A. Contractor shall warrant all products and labor for a period of one year after Substantial Completion.

B. The USPS reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the USPS, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

C. At no cost to the USPS, during the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below:
   1. Maintenance services shall be provided for all devices and hardware specified in sections 233004 through 251404. Service all equipment per the manufacturer's recommendations and maintenance schedule submitted. All devices shall be calibrated within the last month of the warranty period.
   2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the USPS to the Contractor.
      a. Response by telephone to any request for service shall be provided within two (2) hours of the USPS's initial telephone request for service.
      b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the USPS's site within eight (8) hours of the USPS's initial telephone request for such services, as specified.
   3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the USPS to the Contractor.
      a. Response by telephone to any request for service shall be provided within eight (8) working hours (contractor specified 40 hr per week normal working period) of the USPS's initial telephone request for service.
      b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the USPS's site within three (3) working days of the USPS's initial telephone request for such services, as specified.
   4. Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for the USPS to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times. Alternatively, pagers can be used for technicians trained in system to be serviced. One of the three paged technicians shall respond to every call within 15 minutes.
   5. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
   6. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements and submitted maintenance plan.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.13 LISTING AND LABELING

A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General: Provide electronic electric control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, controllers, sensors, and other components as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

B. Communication Wiring: All wiring shall be in accordance with National Electrical Codes and Division 16 of this specification.
   1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).
   2. Local Supervisory LAN: For any portions of this network required under this section of the specification, contractor shall use Fiber or Category 5e of standard TIA/EIA (100/1000BaseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.
   3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.

C. Signal Wiring: Contractor shall run all signal wiring in accordance with National Electric Codes and the Division 16 Specification.
   1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
   2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

D. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with National Electric Codes and the Division 16 Specification.
   1. Low voltage control wiring shall be minimum 16-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

E. Control Panels: Provide control panels with suitable brackets for wall mounting for each control system. Locate panel adjacent to systems served.

1. Fabricate panels of 16-gage furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed on four sides, with hinged door and keyed lock, with manufacturer's standard shop- painted finish and color.
2. Provide UL-listed cabinets for use with line voltage devices.
3. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Control panel shall have standard manufacturer's color.
4. All gauges and control components shall be identified by means of nameplates.
5. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
6. All control tube and wiring shall be labeled to match the control drawing submittals.
7. Complete wiring and tubing termination drawings shall be mounted in or adjacent to panel.

2.2 CONTROL VALVES

A. General: Provide factory fabricated control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

B. Plug-Type Globe Pattern for Water Service:
1. Valve Sizing: Where not specifically indicated on the control drawings, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
2. Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on ‘top-and-bottom’ guided plugs.
3. Double Seated (Three-way) Valves: Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on ‘top-and-bottom’ guided plugs.
4. Temperature Rating: 25°F minimum, 250°F maximum
5. Body: Bronze, screwed, 250 psi maximum working pressure for 1/2” to 2”; Cast Iron, flanged, 125 psi maximum working pressure for 2-1/2” and larger.
6. Valve Trim: Bronze; Stem: Polished stainless steel.
7. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
8. Plug: Brass, bronze or stainless steel, Seat: Brass
9. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
10. Ambient Operating Temperature Limits: -10 to 122°F (-12.2 to 50 °C)
11. Acceptable Manufacturers: Subject to compliance with the above requirements, approved manufacturers are as follows:
    a. Johnson Controls
    b. Invensys
    c. Siemens
    d. Warren
    e. Delta
    f. Belimo

C. Butterfly Type:
1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges.
2. Seat: EPDM, except in loop bypass applications where seat shall be metal to metal
3. Disc: Bronze or stainless steel, pinned or mechanically locked to shaft
4. Bearings: Bronze or stainless steel

5. Shaft: 416 stainless steel
6. Cold Service Pressure: 175 psi
7. Close Off: Bubble-tight shutoff to 150 psi
8. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more that 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no cost to the USPS.
9. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
    a. Jamesbury WS815
    b. Bray Series 31
    c. Keystone AR2
    d. Dezurik BGS

D. Ball Type
1. Body: Brass or bronze; one-, two-, or three-piece design; threaded ends.
2. Seat: Reinforced Teflon
3. Ball: Stainless steel.
4. Port: Standard or 'V' style.
5. Stem: Stainless steel, blow-out proof design, extended to match thickness of insulation.
6. Cold Service Pressure: 600 psi WOG
7. Steam working Pressure: 150 psi
8. Acceptable Manufacturers: Subject to compliance with the above requirements, approved manufacturers are as follows:
    a. Conbraco
    b. Worcester
    c. Nibco
    d. Jamesbury
    e. PBM
    f. Delta
    g. Belimo

E. Segmented or Characterized Ball Type
1. Body: Carbon Steel (ASTM 216), one-piece design with wafer style ends.
2. Seat: Reinforced Teflon (PTFE).
3. Ball: Stainless steel ASTM A351
4. Port: Segmented design with equal-percentage characteristic.
5. Stem: Stainless steel.
6. Cold Service Pressure: 200 psi WOG
7. Cavitation Trim: Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.
8. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
    a. Jamesbury R-Series
    b. Fisher
    c. Substitutions: As allowed in Division 1

2.3 CONTROL DAMPERS

A. General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable air flow. Provide parallel or opposed blade dampers as recommended by manufacturers sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.

B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 fpm (7.62 m/s), differential pressure not greater than 2.5" w.c. (622 Pa):
   1. Performance: Test in accordance with AMCA 500.
   2. Frames: Galvanized steel, 16-gauge minimum thickness, welded or riveted with corner reinforcement.
   3. Blades: Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts with set screws, 16 gauge minimum thickness.
   4. Blade Seals: Synthetic elastomer, mechanically attached, field replaceable.
   5. Jamb Seals: Stainless steel.
   6. Shaft Bearings: Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.
   7. Linkage: Concealed in frame.
   8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.
   9. Leakage: Less than one percent based on approach velocity of 1500 ft./min. (7.62 m/s) and 1 inches wg. (249Pa).
   10. Maximum Pressure Differential: 2.5 inches wg. (622 Pa)
   11. Temperature Limits: -10 to 150 °F (-23 to 65 °C).
   12. Where opening size is larger than 48 inches (1219 mm) wide, or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.

C. For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm (12.7 m/s), differential pressure not greater than 4" w.c. (994 Pa):
   1. Performance: Test in accordance with AMCA 500.
   2. Frames: rolled 12 gauge steel strip for sizes 6 inch and smaller, rolled 14 gauge steel channel for larger sizes, galvanized or aluminum finish.
   3. Blades: Steel construction, 12 gauge minimum thickness for dampers less than 18 inches (457 mm) in size, 10 gauge minimum thickness for larger dampers.
   4. Blade Seals: Full circumference neoprene.
   5. Shaft: ½ inch (12.7 mm) diameter zinc or cadmium plated steel.
   6. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.
   7. Leakage: Less than 0.2 percent based on approach velocity of 4000 ft./min. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.
   8. Maximum Pressure Differential: 4 inches wg. (994 Pa)
   9. Temperature Limits: -40 to 300 °F (-40 to 149 °C).

2.4 ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.

B. Damper Actuators
   1. Ambient Operating Temperature Limits: -22 to 122°F (-30 to 50 °C)
   2. Two Position Electric Actuators: Line voltage with spring return
   3. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-5 Vdc, 0-10 Vdc, 2-10Vdc, 4-20 mA, or PWM input (subject to restrictions) as required. Actuators shall travel full stroke in less than 95 seconds. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have positive positioning circuit. Where two actuators are required in parallel or in sequence provide an auxiliary actuator driver. Actuators shall have current limiting motor protection. Actuators shall have manual override where indicated. Modulating actuators for valves shall have minimum rangeability of 40 to 1.

a. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low pressure steam, and 10 percent for high pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.

b. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:

1) Belimo

2) Johnson Controls

3) Delta

4) Invensys

C. Quarter-Turn Actuators (for ball and butterfly valves):

1. Electric

a. Motor: Suitable for 120 or 240 Volt single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.

b. Gear Train: Motor output shall be directed to a self locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.

c. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure

d. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.

e. Enclosure: Actuator enclosure shall be NEMA-4 rated, and shall have a minimum of two threaded conduit entries. Provide an enclosure heater for actuators located outside of buildings.

f. Limit Switches: Travel limit switches shall be UL and CSA approved. Switches shall limit actuator in both open and closed positions.

g. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.

h. Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.

i. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.

j. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.

k. Position Controller: For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 Vdc, 2-10 Vdc, and 135 Ohm potentiometer.

l. Ambient Conditions: Actuator shall be designed for operation from –22 to 122 °F ambient temperatures with 0 to 100 percent relative humidity.

2.5 GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally ‘two-wire’ type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with ‘two-wire’ type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide ‘four-wire’ type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.6 TEMPERATURE SENSORS (TS)

A. Sensor range: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.3°F (0.16 °C) (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25°F over 5 years.

B. Matched Sensors: The following applications shall require matched sensors. Refer to Section 251104:
   1. Building Loop Connections: Provide matched loop and building supply sensors where control sequence requires controlling to a temperature rise (differential).
   2. Hydronic Temperature Difference Calculations: Provide matched supply and return temperature sensors where the pair is used for calculating temperature difference for use in load calculations or sequencing such as across chillers and plants.
   3. Air Handling Unit Sequencing: Provide matched pair for the cooling and heating coil leaving sensors where the sequence includes calculating an offset from the supply air setpoint to maintain a leaving heating coil temperature.

C. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting. Provide insulated base. Following sensing elements are acceptable:
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.5°F accuracy at calibration point.
   2. Provide setpoint adjustment. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BAS.
   3. Provide an occupancy override button on the room sensor enclosure. This shall be a momentary contact closure
   4. Provide current temperature indication via an LCD or LED readout where indicated.

D. Single-Point Duct Temperature Sensor: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 316 stainless steel.
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.36°F accuracy at calibration point

E. Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area. An averaging duct temperature sensor shall be used in ducts where stratification of the airstream may occur. i.e. mixed air temperatures, coil discharge temperatures, etc. Temperature range shall be as required for resolution indicated in paragraph A.
   1. Sensing element shall be platinum RTD, or thermistor, +/- 0.36°F accuracy at calibration point.

F. Liquid immersion temperature sensor shall include brass thermowell, sensor and connection head for wiring connections. Temperature range shall be as required for resolution of 0.15°F.
   1. Sensing element (chilled water/glycol systems) shall be platinum RTD +/- 0.36°F accuracy at calibration point. Temperature range shall be as required for resolution of 0.15°F.
   2. Sensing element (other systems) shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point. Temperature range shall be as required for resolution of 0.3°F.

G. Pipe Surface-Mount Temperature Sensor: Shall include metal junction box and clamps and shall be suitable for sensing pipe surface temperature and installation under insulation. Provide thermally conductive paste at pipe contact point. Temperature range shall be as require for resolution indicated in paragraph A. Surface-Mount temperature sensors shall only be used where specifically indicated on the drawings or specifications.
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.

H. Outside air sensors shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as require for resolution indicated in Paragraph A
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.

2.7 TEMPERATURE TRANSMITTERS

A. Where required by Controller, or where wiring runs are over 50 feet, sensors as specified above may be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1°F when applied to the sensor range.

2.8 HUMIDITY TRANSMITTERS

A. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:
   1. Input Range: 0 to 100% RH.
   2. Accuracy(% RH): +/- 2% (when used for enthalpy calculation, dewpoint calculation or humidity control) or +/- 3% (monitoring only) between 20-90% RH at 77°F, including hysteresis, linearity, and repeatability.
   3. Sensor Operating Range: As required by application
   4. Long Term Stability: Less than 1% drift per year.

B. Acceptable Manufacturers: Units shall be Vaisala HM Series, General Eastern, Microline, or Hy-Cal HT Series. Substitutions shall be allowed per Division 1.

C. General Purpose Low Pressure Air: Generally for use in static measurement of duct pressure or constant volume air velocity pressure measurement where the range is applicable.
   1. General: Loop powered two-wire differential capacitance cell-type transmitter.
   2. Output: two wire 4-20 mA output with zero adjustment.
   3. Overall Accuracy: Plus or minus 1%.
   4. Minimum Range: 0.1 in. w.c.
   5. Maximum Range: 10 inches w.c.
   6. Housing: Polymer housing suitable for surface mounting.
   7. Acceptable Manufacturers: Modus T30. Substitutions shall be allowed per Division 1.
   8. Static Sensing Element: Provide pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.

9. Range: Select for specified setpoint to be between 25% and 75% full-scale.

D. General Purpose Low Pressure/Low Differential Air: Generally for use in static measurement of space pressure or constant volume air velocity pressure measurement where the range is applicable.
1. General: Loop powered, two-wire differential capacitance cell type transmitter.
2. Output: Two-wire 4-20 mA output with zero adjustment.
3. Overall Accuracy: Plus or minus 1%.
4. Minimum Range: 0 in. w.c.
5. Maximum Range: 0.1, 0.25, or 0.5 inches w.c.
6. Housing: Polymer housing suitable for surface mounting.
7. Acceptable Manufacturers: Modus T30. Substitutions shall be allowed per Division 1.
8. Static Sensing Element: Provide pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing, where applicable.
9. Range: Select for specified setpoint to be between 25% and 75% full-scale.

2.9 DIFFERENTIAL PRESSURE SWITCHES (DPS)

A. General Service - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing

B. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential, and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0°F to 160°F operating temperature range.

2.10 PRESSURE SWITCHES (PS)

A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.

B. Acceptable Manufacturers: Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Cleveland Controls. Substitutions are acceptable when approved by the USPS.

2.11 TRANSDUCERS

A. Binary to Analog Transducers (Pulse Width Modulating or Tri-State-to-Voltage or -Current):
1. Adjustable zero and span.
2. Failure Mode on Power Loss: Shall be provided with memory feature to allow the transducer to return to last value on power failure.
3. Accuracy: ± 1% of span
4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10Vdc, 2-10Vdc, 0-15Vdc, 3-15Vdc
5. Input: 4-20 mA, pulse width modulated or tri-state input.
6. [Pulse Width Modulated] and Tri-state Input Time Base: Dip switch selectable.
7. Enclosure: Polymer designed for surface or panel mount.
8. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.
9. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1..

B. Electronic-to Electronic (Voltage or Current to Current or Voltage):
1. Adjustable zero and span.
2. Failure Mode on Power Loss: Memory feature to allow the transducer to return to last value on power failure.
3. Accuracy: ± 1% of span.

4. Output Span: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, 3-15 Vdc.
5. Input: 0-20 Vdc, 0-20 ma, 0-10 kOhm.
6. [Pulse Width Modulated and]Tri-state Input Time Base: Dip switch selectable
7. Enclosure: Polymer enclosure designed for surface or panel mount.
8. Acceptable Manufacturers: RE Technologies Model PWA Series. Substitutions shall be allowed per Division 1.

2.12 CURRENT SWITCHES (CS)

A. Clamp-On or Solid-Core Design Current Operated Switch (for Constant Speed Motor Status Indication)
1. Range: 1.5 to 150 amps.
2. Trip Point: Adjustable.
3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
4. Lower Frequency Limit: 6 Hz.
5. Trip Indication: LED
6. Approvals: UL, CSA
7. Max. Cable Size: 350 MCM
8. Acceptable Manufacturers: Veris Industries H-708/908; Inc., RE Technologies SCS1150A-LED. Substitutions shall be allowed per Division 1.

B. Clamp-on or Solid-Core Wire Through Current Switch (CS/CR) (for Constant Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries, Inc., Model # H938/735; or RE Technologies RCS 1150. Substitutions shall be allowed per Division 1.
1. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing similar with override switch to Kele RIBX. Substitutions shall be allowed per Division 1.

C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication
1. Range: 1.5 to 135 Amps.
2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
4. Frequency Range: 5-75 Hz
5. Trip Indication: LED
6. Approvals: UL, CSA
7. Max. Cable Size: 350 MCM
8. Acceptable Manufacturers: Veris Industries, Inc. H-904. Substitutions shall be allowed per Division 1.

D. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Veris Industries, Inc., Model # H934. Substitutions shall be allowed per Division 1.

E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.13 OUTDOOR AIR STATIC PRESSURE SENSING TIP

A. Pressure sensor: Pressure sensing tip shall be designed to minimize the effects of wind and resulting velocity pressure up to 80 mph. Acceptable manufacturers shall be Dwyer A-306. Substitutions shall be allowed per Division 1.

B. Low Air Pressure Surge Dampener: 30-second time constant. Acceptable manufacturer shall be Modus SD030. Substitutions shall be allowed per Division 1.

2.14 AIRFLOW MEASURING STATIONS (AFMS)

A. Pitot Tube Grids: Provide an array of velocity pressure sensing elements with averaging manifolds and air straightening vanes packaged in a sheet metal casing. Distribute sensing elements in accordance with ASHRAE for traversing ducts. Provide taps to connect tubing from instrumentation. Label AFM with drawing number designation, design flow, velocity pressure, and pressure drop. Application of pitot grids shall be allowed only where minimum expected flow is greater than 30% or maximum flow

B. Hot Wire Grid: Provide an array of hot wire anemometer with air straightening package in a sheet metal casing. Provide averaging circuitry and transmitter to transmit a linear signal proportional to airflow.

C. Vortex Shedding Grid: Provide an array of vortex shedding elements designed to produce stable 'Karmen Vortices' that are linear with air velocity. Provide the electronics to totalize the pulses and output average velocity proportional to an output signal of 4-20ma.
   1. Sensor Accuracy: ±1.5%
   2. Electronics Accuracy: ±0.5%
   3. Range: Select minimum range to accommodate the expected flow range of the project
   4. Temperature Limits: 20-140°F
   5. Acceptable Manufacturer: Tek-Air Systems Inc. 'Vortek' Model. Substitutions shall be allowed per Division 1.

2.15 AIR VELOCITY PRESSURE SENSORS

A. Single or Multi-Point Averaging (as indicated): Sensing tip shall be for insertion into duct with mounting flange and push on tube connections. Material shall be suitable to the application.

2.16 ELECTRIC CONTROL COMPONENTS

A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley. Substitutions shall be allowed per Division 1.

B. Electric Solenoid-Operated Pneumatic Valves (EP): EP valves shall be rated for a minimum of 1.5 times their maximum operating static and differential pressure.. Valves shall be ported 2-way, 3-way, or 4-way and shall be normally closed or open as required by the application. EPs shall be sized for minimum pressure drop, and shall be UL and CSA listed. Furnish and install gauges on all inputs of EPs. Furnish an adjustable air pressure regulator on input side of solenoid valves serving actuators operating at greater than 30 psig.
   1. Coil Enclosure: Indoors shall be NEMA-1, Outdoors and NEMA-3, 4, 7, 9.
   2. Fluid Temperature Rating: Valves for compressed air and cold water service shall have 150 °F (66 °C) minimum rating. Valves for hot water or steam service shall have fluid temperature rating higher than the maximum expected fluid temperature.
   3. Acceptable Manufacturers: EP valves shall be as manufactured by ASCO or Parker. Substitutions shall be allowed per Division 1.

4. Coil Rating: EP valves shall have appropriate voltage coil rated for the application (i.e., 24 VAC, 120 VAC, 24 VDC, etc.).

C. Low Temperature Detector ('Freezestat') (FZ): Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8" x 20' (3.2mm x 6.1m), junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPST (4 wire, 2 circuit) with manual reset. Temperature range 15 to 55°F (-9.4 to 12.8°C), factory set at 38°F.

D. High Temperature Detectors ('Firestat') (FS): High temperature detector shall consist of 3-pole contacts, a single point sensor, junction box for wiring connections and gasket to prevent air leakage of vibration noise, triple-pole, with manual reset. Temperature range 25 to 215°F (-4 to 102°C).

E. Surface-Mounted Thermostat: Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 90° F (10 to 32°C) , and a minimum 10°F fixed setpoint differential.

F. Low Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT sealed mercury contacts, operating temperature range of 50 to 90°F (10 to 32°C), switch rating of 24 Vac (30 Vac max.), and both manual and automatic fan operation in both the heat and cool modes.

G. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
   a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
   b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
   c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
   d. Pilot light indication of power-to-coil and coil retainer clips.
   e. Coil rated for 50 and 60 Hz service.
   f. Acceptable Manufacturers: Relays shall be Potter Brumfield, Model KRPA. Substitutions shall be allowed per Division 1.
2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC. Substitutions shall be allowed per Division 1.
3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

H. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse. Substitutions shall be allowed per Division 1.

I. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall be fused in accordance with the NEC. Transformer shall be proper size for application, and mounted in minimum NEMA-1 enclosure.
1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson. Substitutions shall be allowed per Division 1.

J. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a dustproof enclosure.
1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.
2. TDRs shall be UL and CSA listed, Crouzet type.

K. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley. Substitutions shall be allowed per Division 1.

L. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

M. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory. Substitutions shall be allowed per Division 1.

N. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley. Substitutions shall be allowed per Division 1.

2.17 SMOKE CONTROL

A. Integral enunciator/control panel part of complete engineered and UUKL 864 listed system.

B. Provide clear, laminated graphic schematically representing the building air systems. Status LEDs shall be associated with graphic representations of fans. Override switches shall be provided as required by NFPA 110 to allow override of the fans and dampers applicable to the code requirements.

2.18 NAMEPLATES

A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 thick, black, with white center core, and shall be minimum 1" x 3", with minimum 1/4" high block lettering. Nameplates for devices smaller than 1" x 3" shall be attached to adjacent surface.

B. Each nameplate shall identify the function for each device.

2.19 TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range).

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Refer to additional requirements in other sections of this specification.

3.3 DIGITAL CONTROL STATIONS, CONTROLLER QUANTITY AND LOCATION

A. Individual Digital Control Stations (DCS) are referenced to indicate allocation of points to each DCS and DCS location. Digital control stations shall consist of one or multiple controllers to meet requirements of this specification.

B. Where a DCS is referenced, Contractor shall provide at least one (1) controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Restrictions in applying controllers are specified in Section 251404: BAS Field Panels.. This Contractor shall extend power to the DCS from an acceptable power panel. If the control contractor wishes to further distribute panels to other locations, control contractor is responsible for extending power to that location also. Furthermore, contractor is responsible for ensuring adequate locations for the panels that do not interfere with other requirements of the project and maintain adequate clearance for maintenance access.

C. Contractor shall locate DCSs as referenced. It is the Contractor's responsibility to provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.

D. Contractor shall provide a minimum of the following:
   1. One DCS (including at least one controller) in each chilled water plant mechanical room.
   2. One controller for each air handler located in applicable mechanical room.
   3. One controller shall be provided for each terminal unit unless indicated otherwise.

3.4 SURGE PROTECTION

A. The Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AAC/ASCS operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no affect on hardware, software, communications, and data storage.

3.5 CONTROL POWER SOURCE AND SUPPLY

A. Section 250504 Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Sections 250504 through 251404 and the Sequences of Operation unless specifically shown on the drawings for specific locations.

B. General requirements for obtaining power include the following:
   1. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.
   2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment’s control transformer is large enough and of the correct voltage to supply the control system it may be used. If the equipment’s control transformer is not large enough or of the correct voltage to supply the controls provide separate transformer

3. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served. Furthermore, the controller in that condition shall monitor each power type served to determine so logic can assess whether a failure is due to a power loss and respond appropriately. A three-phase monitor into a digital input shall suffice as power monitoring.
4. Standalone Functionality: Refer to Section 251404.

3.6 BAS START UP, COMMISSIONING AND TRAINING

A. Refer to Section 250804

3.7 SEQUENCE OF OPERATION

A. Refer to Section 230905

B. OUTDOOR AIR CONDITION MONITORING
1. The controller will read the outside air temperature and humidity and calculate the outside air enthalpy, and will make these values available to the system.
2. If the outside air temperature sensor is out of the normal set point parameter after a time delay (adj.), the controller will generate a sensor failure

C. OPTIMAL START PROGRAM (OSP)

1. The Building Automation System (BAS) or Energy Management System (EMS) shall control the various Day/Night zones based upon an operator interactive time-of-day (TOD) program.
2. The TOD program shall interact with an optimal start program (OSP) such that start times shall be assigned by the OSP to achieve the target occupancy space temperature (72° F winter, 75° F summer) at the precise time of building occupancy.
3. Refer to the various sequences of operation to determine the amount of Day/Night zones required.
4. During morning warm-up, all outside air dampers shall be full closed.

D. DAY/NIGHT ZONE CONTROL
1. The facility shall be divided into day/night zones as indicated below. The unoccupied heating temperature setpoint for all zones is 55° F. The unoccupied cooling setpoint is indicated in the table.
2. The BAS/EMS shall control the building zones on the following occupied schedule:

Area	Weekday	Saturday	Sunday	Unoccupied Cooling
Workroom	Day	Day	Night	88°F
Docks	Day	Day	Night	NA
Administration	Day	Day	Night	88°F
Data Centers	N/A	N/A	N/A	74°F
Cafeteria	N/A	N/A	N/A	88°F
Lobbies	N/A	N/A	N/A	88°F

E. GENERAL MOTOR STARTING REQUIREMENTS
1. Motors shall be started with a minimum delay of 5 seconds (adj.) between motors except when simultaneous operation sequence is required.
2. Motors equipped with VFD's shall initially start at 30% speed (adj.) and then ramp up to the required operating speed.
3. AHU and return/relief fan motors shall not be allowed to start until the associated return damper end switch is proven open.

F. HEATING HOT WATER SYSTEM CONTROL
1. Sequence of operations: Refer to section 230905
2. Energy Monitoring

G. SINGLE ZONE AIR HANDLER SYSTEM CONTROL
1. Sequence of operations: Refer to section 230905
2. Energy Monitoring
   a. Through the system VFD communication interface provide points and trending as indicated in the attached points list

APPENDIX A

System Point Lists

A. Purpose: The following point list tables identify the general system control and monitoring points expected to be implemented for each system. Additional points may be needed to fully implement the control sequences and calculation algorithms. This should be included in the submittals specified in other sections. All additional points shall be follow the point naming convention established in related sections.

B. Point List table descriptions
   1. Point ID: system point name following point naming standard established in related sections.
   2. Description: Additional descriptive information relating to the point to expound on the system Point ID.
   3. Control SP: For points in control loops, the control loop setpoint.
   4. Alarm Data: Identification of alarm levels for the point identified. Contractor shall provide alarm objects for set with the identified parameters
   5. Trend Data: Indication of which points shall be trended and in what manner. All trends are stored in the file panel local memory.
      a. Type: COV - change in value, value recorded and time stamped when value changes by a set threshold; Time – value recorded and time stamped at set time intervals.
      b. Freq.: Set frequency interval, in minutes, a time based trend is stored.
      c. Min Storage: The minimum number of samples either time based or COV to be stored in the field panel.
   6. Graphic Display: This group is and indication of where points shall be shown on system graphics and trend graph groupings. This is a general assignment of system points to graphic displays and graphs. Additional points may need to be shown to ease of operator functionality. All graphics and graphs shall be mocked up and submitted for approve before final programming.
      a. System Diagram: The graphic screen, at a minimum on which the point is to be presented.
      b. Trend graph: The trend graph grouping to which the point should be assigned. Trend graphs shall have their vertical scale set to include the typical range of the operating parameters measured. Scales shall be fixed to allow vertical units to be easily read values. On trend groupings with diverse parameters, a second vertical axis shall be set to all reasonable comparisons of the relationships between parameters.
   7. EEMS: This group is an indication of which points shall be collected by the EEMS server for remote monitoring, display, alarm and historical archiving.
      a. Server points: The indicated points' BACnet objects and any associated alarm and trend objects will be retrieved for real time display at the EEMS server by the EEMS contractor.
      b. Trend Archive: The indicated points will be formatted into trend archiving in the EEMS by the EEMS contractor.

Points List – Hot Water Systems

Unit Point ID ?= State, .Facility ID AB.CCCCCCCC	Description		Alarm Data						Trend data				Graphic Display		EEMS	
		Control SP	Hi Alarm	SP	Low Alarm	SP	Status Alarm	See Note	Type	Freq.	Min. Storage Note 3	Totalize Note 2	System Diagram	Trend Graph	Server Points	Trend Archive
??.HHW.SYS.SWT..	SUP WTR TEMP								TIME	5	2100			1	X	X
??.HHW.SYS.SWS..	SUP WTR STPT								TIME	5	2100			1	X	X
??.HHW.SYS.BPV..	WTR MIX VALVE								TIME	5	2100			1	X	
??.HHW.SYS.RWT..	RTN WTR TEMP								TIME	5	2100			1	X	X
??.HHW.SYS.DT..	WTR DT								TIME	5	2100			1	X	
??.HHW.SYS.FLOW..	WATER FLOW								TIME	5	2100				X	X
??.HHW.SYS.BTU..	SYSTEM BTU								TIME	5	2100	MBTUH		1	X	X
??.HHW.SYS.BTUH..	SYSTEM BTUH								TIME	15	1000				X	X
??.HHW.SYS.PSI	SYS PRESSURE		X		X				TIME	5	2100			2	X	
??.HHW.SYS.PSD	SYS DIFF PRES		X		X				TIME	5	2100			2	X	
??.HHW.SYS.PSS	SYS PRES STPT								TIME	5	2100			2	X	
??.HHW.HWP#.SS..	START/STOP								COV		200	HOURS			X	
??.HHW.HWP#.RT..	RUN TIME								TIME	15	1000				X	X
??.HHW.HWP#.PVO..	VFD OUTPUT								TIME	5	2100			2	X	
??.HHW.HWP#.SPD..	SPEED %								TIME	5	2100			2	X	
??.HHW.HWP#.KW..	PUMP KW								TIME	5	2100	kWh		2	X	X
??.HHW.HWP#.KWH..	PUMP ENERGY								TIME	15	1000				X	X
??.HHW.BLR#.STS..	BLR# STATUS								COV		200				X	
??.HHW.BLR#.ALM..	BLR# ALARM								COV		200				X	
??.HHW.BLR#.PMP.SS.	BLR# PUMP STAT								COV		200				X	

Note 1:
Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh; BTUh to the 0.1 MBTUH
Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.
Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data Provide a link on the system or data table graphics.
Graph 1: System Temperatures: scale system BTU on secondary axis
Graph 2: System Operation combine all pumps on one graph.
Graph 3:

Points List – Single Zone Air Handlers

Unit Point ID ?= State, .Facility ID AB.CCCCCCCC	Description	Alarm Data							Trend data				Graphic Display		EEMS	
		Control SP	Hi Alarm	SP	Low Alarm	SP	Status Alarm	See Note	Type	Freq.	Min. Storage Note 3	Totalize Note 2	System Diagram	Trend Graph	Server Points	Trend Archive
?.AH.AHU#.MODE..	AHU MODE								COV		300				X	
?.AH.AHU#.RAT..	RA TEMP								TIME	5	2100			1	X	X
?.AH.AHU#.RAH..	RA HUMIDITY								TIME	5	2100				X	
?.AH.AHU#.RAE..	RA ENTHALPY								TIME	5	2100			1	X	
?.AH.AHU#.MAT..	MIXED AIR TEMP				X				TIME	5	2100			1,2	X	X
?.AH.AHU#.MAS..	MIXED AIR STPT								TIME	5	2100			1	X	X
?.AH.AHU#.MAD..	MIXED AIR DMPR								TIME	5	2100			1	X	X
?.AH.AHU#.LTD..	LTD						X		COV		200				X	
?.AH.AHU#.FLT.DP.	FLTR DIFF PRES		X						TIME	5	2100			3	X	
?.AH.AHU#.OAD..	OA DMPR								TIME	5	2100			1	X	
?.AH.AHU#.OAF..	OA FLOW				X				TIME	5	2100			1	X	X
?.AH.AHU#.OAS..	OA FLOW STPT								TIME	5	2100			1	X	
?.AH.AHU#.OAT..	OA TEMP								TIME	5	2100			1	X	X
?.AH.AHU#.OAE..	OA ENTHALPY								TIME	5	2100			1	X	
?.AH.AHU#.HCV..	HTG COIL VLV								TIME	5	2100			2	X	X
?.AH.AHU#.CCV..	CLG COIL VLV								TIME	5	2100			2	X	X
?.AH.AHU#.SF.SS.	S FAN STATUS								COV		200	HOURS			X	
?.AH.AHU#.SF.VDO.	S FAN VFD CNTRL								TIME	5	2100			3	X	
?.AH.AHU#.SF.SPD.	S FAN VFD %								TIME	5	2100			3	X	X
?.AH.AHU#.SF.KW.	S FAN KW								TIME	5	2100	KWH		3	X	X
?.AH.AHU#.SF.KWH.	S FAN ENERGY								TIME	15	1000				X	X
?.AH.AHU#.SF.RT.	S FAN RUN TIME								TIME	15	1000				X	X
?.AH.AHU#.SF.ALM.	S FAN VFD ALARM						X		COV		200				X	
?.AH.AHU#.SAT..	SUP AIR TEMP								TIME	5	2100			2	X	X
?.AH.AHU#.SAS..	SUP AIR STPT								TIME	5	2100			2	X	X
?.AH.AHU#.SAH..	SUP AIR HUMIDT								TIME	5	2100				X	
?.AH.AHU#.SAE..	SUP AIR ENTH								TIME	5	2100				X	
?.AH.AHU#.RMT..	ROOM TEMP								TIME	5	2100				X	X
?.AH.AHU#.RMCS..	ROOM CLG STPT				X				TIME	5	2100			2	X	X
?.AH.AHU#.RMHS..	ROOM HTG STPT		X						TIME	5	2100			2	X	X

?.AH.AHU#.RMH..	ROOM HUMIDITY								TIME	5	2100				X	
?.AH.AHU#.RMC..	ROOM CO2		X						TIME	5	2100			1	X	X
.....																
ALTERNATIVE POINTS - RELIEF/EXHAUST FANS.....																
?.AH.AHU#.REF.SS.	RLF FN STATUS								COV		200	HOURS			X	
?.AH.AHU#.REF.VDO.	RLF FN VFD CNTRL								TIME	5	2100			3	X	
?.AH.AHU#.REF.SPD.	RLF FN VFD %								TIME	5	2100			3	X	X
?.AH.AHU#.REF.KW.	RLF FN KW								TIME	5	2100	KWH		3	X	X
?.AH.AHU#.REF.KWH.	RLF FN ENERGY								TIME	15	100				X	X
?.AH.AHU#.REF.RT.	RLF FN RUN TIME								TIME	1	100				X	X
?.AH.AHU#.REF.ALM.	RLF FN VFD ALRM								COV		200				X	
?.AH.AHU#.REF.DMPR.	RELIEF DMPR								TIME	5	2100				X	

Note 1: System modes and status shall include all specified modes of system operation. (Cool, Heat, Auto, Off) (Cool, Heat, Off))
Note 2: Totalize as follows: Run hours to the 0.1 hour; kWh to the integer kWh;
Note 3: Trend data shall be retained in field panel for the sample quantity indicated and backed up to server at a minimum on a daily basis.
Trend Graph Descriptions: Trend graphs shall display 7 days historical trend data Provide a link on the system or data table graphics.
Graph 1: Mixed Air Operation
Graph 2: System Temperatures
Graph 3: System Power/Flows

END OF SECTION

SECTION 251304
FACILITY SYSTEM INTEGRATION INTO ENTERPRISE ENERGY MANAGEMENT SYSTEM (EEMS)

1.1 SECTION INCLUDES

A. General installation and integration requirements necessary to establish monitoring / control capabilities between USPS building systems such as lighting and HVAC control systems and EEMS thru the installation of a Local Interface Device (LID).

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
B. Section 230500 - Common Work Results for HVAC
C. Section 238100 – Decentralized Unitary HVAC Equipment
D. Section 230593 – Testing, Adjusting and Balancing for HVAC
E. Section 230800 – Commissioning of HVAC
F. Section 230904 - Instrumentation and Control For HVAC (CSF Medium)
G. Section 260500 – Common Work Results for Communications
H. Section 260533 – Raceway and Boxes for Electrical Systems

1.3 DESCRIPTION OF WORK

A. The USPS Enterprise Energy Management System (EEMS) is an existing Ethernet/Internet-based network system connecting multiple facilities with a central data warehouse and server. The EEMS is accessible through the US Postal Service Network via standard web browser.
B. Contractor shall provide all interface devices, software and installation required to successfully establish communication between USPS building systems and EEMS via the Postal Routed Network (PRN). The two basic building system scenarios outlined below and covered by this specification are:
   1. Facilities with Only RTUs and Manual Controls (i.e., thermostats) – In this scenario the LID shall function in a supervisory role to manage RTUs and have intelligent controllers which replace manual controls. The intelligent controllers shall provide real-time capabilities that monitor, control, store, and transmit facility energy consumption and operational data over the PRN.
   2. Facilities with Existing Building Automation Systems (BAS) – In this scenario the LID shall integrate with existing building control systems and only monitor specific system points (see Attachment A) The LID function as a gateway to communicate with the EEMS. The solution shall provide real-time capabilities that monitor, store, and transmit facility energy consumption and operational data over the PRN. No HVAC or lighting control software is allowed to reside on the LID.

1.4 INSTALLATION REQUIREMENTS

A. All installations shall be in accordance with USPS SDC.
B. All installations shall be in accordance with local electrical codes.
C. All work to be coordinated thru USPS & site
D. All installations shall be in accordance with all USPS IT & Security requirements
E. Installation and integration shall be performed by a qualified system integrator.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturer's offering products which may be incorporated in the Work include the following:

1. Facilities with Existing Building Automation System (BAS) — Vykon JACE Solution
   VYKON
   3951 Westerre Parkway, Suite 350
   Richmond, VA 23233
   Customer Support: 877-305-1745

B. Product options and substitutions: Not Permitted.

2.2 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not used in any way for the permanent installation except where drawings or specs specifically allow existing materials to remain in place.

2.3 NETWORK CONNECTION

A. USPS Enterprise Energy Management Server (EEMS) Workbook: Facilities Energy has developed an EEMS Integration Workbook (see Attachment A) which provides additional details and a record of actions taken during the three phases of integration (Discovery, Integration, and Validation). The Contractor is required to complete the workbook and submit it to Facilities Energy for review / approval upon successful completion of specific milestones during the integration process. The attached copy is a sample, and the Contractor shall request the most current version from Facilities Energy prior to starting this portion of the work.

B. EEMS is a network based system connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser internal to the Postal Network. This is an existing infrastructure and the Contractor is not required to configure any components of this WAN. Contractor is however required to provide a single point of connection (Local Interfacing Device) to the EEMS server utilizing one of the following protocols:
   1. FOX
   2. OBIX
   3. MODBUS (Meters Only)

2.4 LOCAL INTERFACING DEVICE COMMUNICATION REQUIREMENTS

A. The LID shall be a microprocessor-based communications device which acts as a supervisor/gateway (depending on scenario outline above) between the local site building automation devices (lighting control systems, HVAC, etc.) and the USPS network to support remote monitoring capabilities.

B. At a minimum the Contractor installed LID shall communicate with building automation devices through one of the following protocols:
   1. BACnet
   2. MODBUS
   3. LONworks
   4. FOX

C. The LID shall perform information translation between the building automation devices and EEMS and shall be applicable to systems in which the same functionality is not provided in the local building controls.

D. The LID shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply.

E. The LID shall be protected from any memory loss due power failure for a minimum of 14 days.

F. The LID shall be mounted in a lockable enclosure.

G. The LID shall be transparent to control functions.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Contractor shall, through the USPS Project Manager, coordinate a meeting of the relevant subcontractors to review the system configuration and assist in planning the data collection requirements in compliance with project specifications.

B. Examine areas and conditions under which the LID is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF LOCAL INTERFACING DEVICE:

A. General: Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and details shown on drawings.

B. Contractor shall provide all interface devices and software to provide an integrated system.

C. Contractor shall closely coordinate with the USPS, or designated representative, to establish IP addresses and communications to assure proper operation of the building control system on the USPS WAN/LAN.

D. Installation of LID shall be based on the scenarios outlined below:
   1. Facilities with Only RTUs and Manual Controls (i.e., thermostats) – device shall be install in an electrical room.
   2. Facilities with Existing Building Automation Systems (BAS) – device shall be installed in close proximity to the Building Automation System (BAS) computer.
   3. Power requirements are outlined in the manufacturer’s instructions but if necessary may require the installation of a power receptacle in close proximity to the LID.

E. Access to the Local Area Network (LAN) is required to establish communications with LID and EEMS. Contractor shall coordinate with local USPS IT the following:
   1. Location of the nearest LAN access point and if necessary install a LAN drop in close proximity to the LID. If a LAN drop is installed, Local IT shall confirm that it is installed on the proper sub-net before installation contractor leaves facility.
   2. If the BAS and lighting control system computers are not located in same general area to each other, the Contractor shall determine the most efficient means to establish connectivity taking into consideration cabling cost, potential negative impact on system performance, and whether multiple LIDs are required.

F. Submit a request to USPS Facilities Energy to acquire all necessary IP, Gateway and Sub-net Mask addresses. All addresses assigned shall use the hardware code “EM”.

G. The contractor shall deliver to the USPS an updated EEMS Integration Workbook, noting any changes from the initial findings, prior to substantial completion of the system for review and approval.

H. Prior to substantial completion of the system, the contractor shall deliver to the USPS a summary of all trend and schedule objects defined to meet this specification.

I. The contractor shall deliver upon approval by the USPS, the full EEMS Integration Workbook and definitions of all trend and schedule objects to the USPS Remote Enterprise Server contractor for development of system graphics and server database development.

J. Contractor shall coordinate with the USPS Remote Enterprise Server contractor in developing system graphics, commissioning documentation and testing.

K. Contractor shall coordinate with the facility and generate a list contacts that shall be responsible for acknowledgment of EEMS notifications.

3.3 INTEGRATION WITH BUILDING SYSTEMS

A. Contractor shall be compliant with all USPS IT & Security requirements prior to access to the USPS network.

B. The USPS shall provide the following information to the Contractor:
   1. Hardware specifications (Once contract is awarded)
   2. A copy of the Enterprise Energy Management System Integration Workbook (Attachment A)
   3. A list of the minimum points required for integration (Attachment A)
   4. A copy of the current points lists for all designated systems which are to be integrated into EEMS
   5. USPS point naming convention standard (Attachment A)
   6. As-built drawings of systems to be integrated, where available

C. Contractor shall deliver a completed copy of the Enterprise Energy Management System Integration Workbook to USPS Facilities Energy and receive approval prior to performing any integration work.

D. Contractor shall establish communications with all building systems designated by the USPS. If communications cannot be successfully established, then the Contractor is to provide a proposed solution and cost estimate for USPS review.

E. If necessary, the Contractor shall create/configure any necessary conversion tables within the LID so that all monitored EEMS points sent to the EEMS server follow the point naming convention and expected value as outlined in Attachment A.

F. All monitored points must be mapped to the EEMS (Tridium AX Supervisor) and follow established point naming conventions.

G. Contractor is responsible for commissioning the integration of the system, which will require coordinating efforts with EEMS technical support.

H. The contractor shall deliver to the USPS a Point Summary Table and summary of all trend & schedule objects prior to substantial completion of the system for review and approval.

3.4 POINT STRUCTURING AND NAMING

A. General: The intent of this section is to require a consistent means of naming points across all USPS facilities. Contractor shall configure the systems from the perspective of the EEMS, not solely the local project. The Contractor shall submit a proposed Point Summary Table (Attachment A) for review and approval prior to any object programming or project startup.

B. All point names shall adhere to the format as in Attachment A. The naming convention shall apply to all physical I/O points, virtual points, calculated points, and all application program parameters.

C. The USPS shall designate the Building Name and Facility ID.

3.5 DOCUMENTATION

A. Provide written description of the LID location (pictures if possible)
B. Document all addresses used
   1. IP
   2. Gateway
   3. Sub-net Mask
C. Document all building systems integrated
D. Commissioning documentation
E. A copy of all documentation sent to Facilities Energy

END OF SECTION

EEMS Facility Integration
Validation Test

Site Name: Lexington Post Office

Validation Test Performed By:

Facility ID:

Date of 1st Validation:

Integration Vendor:

If Re-tested, Performed by:

Date Site Submitted Validation Testing:

Re-test Date:

USPS Use Only

Validation Test Status	USPS Review Comments	USPS Representative	Date
Approved			
Not Approved X			

	Description	Pass / Fail	Comments
1.)	Site Connectivity		**Testing Comments (date):** **Integration Contractor Response (date):**
2.)	Jace Site name consists of "USPS" followed by the facility ID		**Testing Comments (date):** **Integration Contractor Response (date):**
3.)	Validate that histories from the points list (provided by Parsons) are present and have been populated within the last 30 minutes.		**Testing Comments (date):** **Integration Contractor Response (date):**
4.)	Validate that HeatCoolMode, Temp and OccupancyStatus history data consists of data from the following domains:		
	HeatCoolMode - -1,0,1,2,3		**Testing Comments (date):** **Integration Contractor Response (date):**
	OccupancyStatus – True,False		**Testing Comments (date):** **Integration Contractor Response (date):**
	Temp – Numeric, non-null values		**Testing Comments (date):** **Integration Contractor Response (date):**
5.)	Validate Point naming conventions such as * AHUs should start with AHU (eg AHU_01) *VAVs should start with VAV (eg VAV_01		**Testing Comments (date):** **Integration Contractor Response (date):**
6.)	Other valid equipment types: Boiler, CWS, CHWS, CHWSYS, Chiller, Dock Door, FCU, GMF HWS, HVC, HWS, HWSYS HWS OB, Home, Lighting, MUA, RTU, Switch, Utilities, Utility, VAV, VMF AHU, VMF, HWS,Acs		**Testing Comments (date):** **Integration Contractor Response (date):**
7.)	Validate existence of UnitName, AreaName, ZoneName, HeatCoolMode, OccStatus, and SpaceTemp, or AvgSpaceTemp, or ZoneSpaceTemp points for each device for the following device types: AHU, VAV, FCU, MAU, RTU, ACs		**Testing Comments (date):** **Integration Contractor Response (date):**
8.)	In OBIX confirm all instances of HeatCoolMode, OccStatus, and SpaceTemp, AvgSpaceTemp, or ZoneSpaceTemp points and confirm that they are not null, stale, or in an error state.		**Testing Comments (date):** **Integration Contractor Response (date):**
9.)	Confirm that OBIX data is being populated every 15 minutes without gaps.		**Testing Comments (date):** **Integration Contractor Response (date):**

Integration Point Summary Table

Facility Information

Facility Name: Lexington Post Office

Facility ID:

EEMS Integration Phases

1.) Discovery - enter vendor and date Discovery completed

Vendor: Date:

Record the BAS vendor & contact info who assisted with Discovery

Vendor:

System Information - make/model/software version

BAS:

LCS:

2.) Integration - enter vendor and date integration completed

Vendor: Date:

JACE Information: record JACE ID & IP address, USPS switch JACE plugged into & port #

* Station Name = USPSFacilityID#_JACE#, example = USPS356956G01_1

	JACE ID (Station Name)	Platform Daemon Credentials		IP Address	USPS Switch ID or Name	Port # JACE Plugged Into	DEV NCRB#
		Username	Password				
1st JACE	uspsxxxxxxxxx_1						
2nd JACE							
3rd JACE							
4th JACE							

Out of Scope Work (if necessary to monitor required points)

Brief Description		$
1.) BAS		
2.) LCS		
3.) Other		
	Total	$ -

HVAC & LCS Required Monitored Point Assessment

Devices Monitored - HVAC & LCS

Total # of units monitored/controlled by BAS and LCS if present / Total # of units present including lighting control system = #DIV/0!

Points Monitored

Number of Points Monitored (X+O) = As-is #DIV/0!

Total Number of Required Points within the BAS & LCS (X+O+P+S) w / Prog #DIV/0!

USPS Action

Systems & Devices Monitored

Devices Monitored	AHU	RTU	VAV	MAU	FCU	HWS	Boiler	CWS	HVC	Lighting (LCS)	Utilities	Renewables	Total
# of units monitored/controlled by BAS and if a lighting control system is present/functional													-
# of units not monitored/controlled by BAS / lighting control system isn't functional (NM)													-
Facility Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Points Monitored													
Number of points acquired for monitoring (X)													-
Number of points omitted thru application of points rules (O)													-
Number of points which requires additional programming to be made available (P)													-
Number of required points which can not be monitored due to BAS or LCS system Issues (S)													-
Number of **required** points which do not exist in BAS (U)													-

Comments:

Device Point Summary Table

Example

Point Status

X = point acquired for monitoring
O = point omitted thru application of points rules
P = point requires additional programming to be made available
S = unable to acquire point due to BAS system issue ie potential negative impact to BAS performance, hardware limitation or programming problem
U = point does not exist in the BAS
NM = Unit not monitored or controlled by BAS

Sum of Monitored Pts				
X	O	P	S	U
12	12	6	0	9

Device Type	Point Category	Primary / Secondary	Required for EEMS Alarming	Possible Point Names Within The Building Automation System (BAS) & Lighting Control System (LCS) Which Are Interperted By the LID	Required Point Name & Value Transmitted to EEMS Application From LID			AHU 1	AHU 2	AHU 3	AHU 4
					EEMS Standard Name	Minimum Points Required / Unit	Required Value				
Air Handling Units (AHU)	Space Status	P	Y	Occupied Status	OccStatus	1	True or False	X	X	X	NM
	Set Points	P	N	Cooling Set Point Current Cooling Set Point Occupied Cooling Set Point	OccClgSp	2- 1 cooling set point & 1 heating set point	Numeric (BAS value)	X	X	X	NM
				Unoccupied Cooling Set Point	UnoccClgSp			U	U	U	NM
				Heating Set Point Current Heating Set Point Occupied Heating Set Point	OccHtgSp			X	X	X	NM
				Unoccupied Heating Set Point	UnoccHtgSp			U	U	U	NM
	Space Temperatures	P	Y	Zone Space Temp Space Temperature Zone Temperature Avg. Space Temperature	SpaceTemp	1	Numeric (BAS Value)	P	P	P	NM
		S	N	Zone1 Space Temperature	Zone1SpaceTemp			O	O	O	NM
				Zone2 SpaceTemperature	Zone2SpaceTemp			O	O	O	NM
				Zone3 SpaceTemperature	Zone3SpaceTemp			O	O	O	NM
				Zone4 SpaceTemperature	Zone4SpaceTemp			O	O	O	NM
	Device Status	P	Y	Heat/Cool Mode **OR** Cooling Signal Current Cooling Signal Chilled Water Valve (cooling indicator) Condenser Water Valve (cooling indicator) Heating Signal Current Heating Signal Hot Water Valve (heating indicator) Gas Valve (heating indicator)	HeatCoolMode	1	-1 = Error 0 = Off 1 = Heat 2 = Cool 3 = Both	X	X	X	NM
				Supply Temperature	SupplyTemp	1	Numeric (BAS Value)	P	P	P	NM
		S	N	Supply Fan Fan Status	FanStatus	If available	On or Off	U	U	U	NM

Metadata Definition:

Area -A defined space within a facility which is supported by the HVAC device. All HVAC units shall be assigned to one of the following area's;

- -Workroom
- -Adminstrative/Office
- -Other
- -Docks

Zone - A defined space within a given area ie area = workrm, zones within the workrm may include 1st floor & 2nd floor

Metadata Info					
	Area	Workrm	Admin	Other	Docks
	Zone	East Mezz	Plt Mgr, Maint Mgr		
	Device Mapping -Other Units Supported	VAV 1-25			

Device Point Summary Table

Point Status

X = point acquired for monitoring
O = point omitted thru application of points rules
P = point requires additional programming to be made available
S = unable to acquire point due to BAS system issue ie potential negative impact to BAS performance, hardware limitation or programming problem
U = point does not exist in the BAS
NM = Unit not monitored or controlled by BAS

Sum of Monitored Pts				
X	O	P	S	U
0	0	0	0	0

Device Type	Point Category	Primary / Secondary	Required for EEMS Alarming	Possible Point Names Within The Building Automation System (BAS) & Lighting Control System (LCS) Which Are Interperted By the LID	Required Point Name & Value Transmitted to EEMS Application From LID			RTU 1	RTU 2	RTU 3	RTU 4
					EEMS Standard Name	Minimum Points Required / Unit	Required Value				
Roof Top Units (RTU)	Space Status	P	Y	Occupied Status Effective Occupancy	OccStatus	1	True or False				
	Set Points	P	N	Space Set Point	SpaceSp	2- 1 cooling set point & 1 heating set point unless only Space Set Point is available	Numeric (BAS Value)				
				OR							
				Occupied Cooling Setpoint	OccClgSp						
				Unoccupied Cooling Setpoint	UnoccClgSp						
				Occupied Heating Setpoint	OccHtSp						
				Unoccupied Heating Setpoint	UnoccHtgSp						
	Space Temperatures	P	Y	Space Temperature	SpaceTemp	1	Numeric (BAS Value)				
	Device Status	P	Y	Cooling Signal Cooling Command Stage 1	ClgSignal	1	-1 = Error 0 = Off 1 = Heat 2 = Cool 3 = Both				
				Cooling Command Stage 2	ClgCmdStg2	If available					
				Heating Signal Heating Command Stage 1	HtgSignal	1					
				Heating Command Stage 2	HtgCmdStg2	If available					
		P	Y	Supply Temp	SupplyTemp	1	Numeric (BAS Value)				
		S	N	Supply Fan Supply Fan Command	SplyFanStatus	If available	On or Off				
		S	N	Compressor 1	ComCmdStg1	If available	On or Off				
		S	N	Compressor 2	ComCmdStg2	If available					
					Metadata Info		Area				
							Zone				
							Other Units Supported				

Metadata Definition:

Area -A defined space within a facility which is supported by the HVAC device. All HVAC units shall be assigned to one of the following area's;

- -Workroom
- -Adminstrative/Office
- -Other
- -Docks

Zone - A defined space within a given area ie area = workrm, zones within the workrm may include 1st floor & 2nd floor

Device Point Summary Table

Point Status

X = point acquired for monitoring
O = point omitted thru application of points rules
P = point requires additional programming to be made available
S = unable to acquire point due to BAS system issue ie potential negative impact to BAS performance, hardware limitation or programming problem
U = point does not exist in the BAS
NM = Unit not monitored or controlled by BAS

Device Type	Point Category	Primary / Secondary	Required for EEMS Alarming	Possible Point Names Within The Building Automation System (BAS) & Lighting Control System (LCS) Which Are Interperted By the LID	Required Point Name & Value Transmitted to EEMS Application From LID			HWS 1	HWS 2	HWS 3	HWS 4	Sum of Monitored Pts				
					EEMS Standard Name	Minimum Points Required / Unit	Required Value					X	O	P	S	U
Hot Water Supply (HWS)	Device Status	S	N	Water Supply Temperature	HwSupplyTemp	1	Numeric (BAS Value)					0	0	0	0	0
				Water Return Temperature	HwReturnTemp	1	Numeric (BAS Value)									
Metadata Info							Area									
							Zone									
							Other Units Supported									

Metadata Definition:

Area -A defined space within a facility which is supported by the HVAC device. All HVAC units shall be assigned to one of the following area's;

- -Workroom
- -Adminstrative/Office
- -Other
- -Docks

Zone - A defined space within a given area ie area = workrm, zones within the workrm may include 1st floor & 2nd floor

Other Units Supported - refers to other HVAC devices down stream of primary ie VAV's

Device Point Summary Table

Point Status

X = point acquired for monitoring
O = point omitted thru application of points rules
P = point requires additional programming to be made available
S = unable to acquire point due to BAS system issue ie potential negative impact to BAS performance, hardware limitation or programming problem
U = point does not exist in the BAS
NM = Unit not monitored or controlled by BAS

Device Type	Point Category	Primary / Secondary	Required for EEMS Alarming	Possible Point Names Within The Building Automation System (BAS) & Lighting Control System (LCS) Which Are Interperted By the LID	Required Point Name & Value Transmitted to EEMS Application From LID			Boiler 1	Boiler 2	Boiler 3	Boiler 4
					EEMS Standard Name	Minimum Points Required / Unit	Required Value				
Boiler	Device Status	S	N	Boiler Status Boiler Enable Status Boiler Command	BoilerStatus	1	On or Off				
				Boiler Pump Status Pump Status	PumpStatus	If available	On or Off				
				Firing Status	FiringStatus	If available	On or Off				
				Supply Temp	SupplyTemp	If available	Numeric (BAS Value)				
				Return Temp	ReturnTemp	If available	Numeric (BAS Value)				
				Space Temp	SpaceTemp	If available	Numeric (BAS Value)				
				Hot Water Distribution Pump 1 Status	Pump1Status	If available	On or Off				
				Hot Water Distribution Pump 2 Status	Pump2Status	If available	On or Off				
				Hot Water Distribution Pump 3 Status	Pump3Status	If available	On or Off				

Sum of Monitored Pts				
X	O	P	S	U
0	0	0	0	0

Metadata Definition:

Area -A defined space within a facility which is supported by the HVAC device. All HVAC units shall be assigned to one of the following area's;

- -Workroom
- -Adminstrative/Office
- -Other
- -Docks

Zone - A defined space within a given area ie area = workrm, zones within the workrm may include 1st floor & 2nd floor

Other Units Supported - refers to other HVAC devices down stream of primary ie VAV's

Metadata Info	Boiler 1	Boiler 2	Boiler 3	Boiler 4
Area				
Zone				
Other Units Supported				

Device Point Summary Table

Point Status

X = point acquired for monitoring
O = point omitted thru application of points rules
P = point requires additional programming to be made available
S = unable to acquire point due to BAS system issue ie potential negative impact to BAS performance, hardware limitation or programming problem
U = point does not exist in the BAS
NM = Unit not monitored or controlled by BAS

Device Type	Point Category	Primary / Secondary	Required for EEMS Alarming	Possible Point Names Within The Building Automation System (BAS) & Lighting Control System (LCS) Which Are Interperted By the LID	Required Point Name & Value Transmitted to EEMS Application From LID			CWS 1	CWS 2	CWS 3	CWS 4
					EEMS Standard Name	Minimum Points Required / Unit	Required Value				
Cold Water Supply (CWS)	Device Status	S	N	Enable Status	EnableStatus	If available	On or Off				
				Pump Status	PumpStatus	If available					
				Tower Fan Status	CtFanStatus	If available					
				Tower Low Fan Status	CtLowFanStatus	If available					
				Tower High Fan Status	CtHighFanStatus	If available					
				Supply Temp	SupplyTemp	If available	Numeric (BAS Value)				
				Chilled Water Supply Temp	ChwSupplyTemp	If available					
				Return Temp	ReturnTemp	If available					
				Chilled Water Return Temp	ChwReturnTemp	If available					
				Condenser Water Supply Temp (Cooling Tower)	CwSupplyTemp	If available					
				Condenser Water Return Temp (Cooling Tower)	CwReturnTemp	If available					
				Motor %KW	MotorKw	If available	0 to 100%				
Metadata Info							Area				
							Zone				
							Other Units Supported				

Sum of Monitored Pts				
X	O	P	S	U
0	0	0	0	0

Metadata Definition:

Area -A defined space within a facility which is supported by the HVAC device. All HVAC units shall be assigned to one of the following area's;

- -Workroom
- -Adminstrative/Office
- -Other
- -Docks

Zone - A defined space within a given area ie area = workrm, zones within the workrm may include 1st floor & 2nd floor

Other Units Supported - refers to other HVAC devices down stream of primary ie VAV's

Incoming Utility Assessment

Record all meter information in the table below.

Utility Meter Type	Meter # or Name	Meter Type ie Smart meter	Meter Output (Analog/Digital)	Location in facility	Is Meter Monitored By BAS (Y/N)	F is no then can it be monitored by a JACE?	Comments
Elec Meter #1							
Elec Meter #2							
Elec Meter #3							
Elec Meter #4							
N.Gas Meter #1							
N.Gas Meter #2							
N.Gas Meter #3							
Steam Meter #1							
Steam Meter #2							
Steam Meter #3							

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Basic electrical methods.
2. Grounding and bonding.
3. Hangers and supports.
4. Electrical identification.
5. Motor Starters, controls, and connections to mechanical equipment.
6. Electrical system testing and inspection.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections:
1. Section 220500 - Common Work Results for Plumbing
2. Section 230500 - Common Work Results for HVAC
3. Section 260519 - Low-Voltage Electrical Power Conductors and Cables
4. Section 260533 - Raceway and Boxes for Electrical Systems
5. Section 262416 - Panelboards
6. Section 262726 - Wiring Devices
7. Section 262816 - Enclosed Switches and Circuit Breakers
8. Section 262923 - Variable Speed Drives
9. Section 283100 - Fire Detection and Alarm System (Horn/Strobes)

1.2 REFERENCES

A. National Electrical Contractors Association (NECA):
1. NECA SI - Standard of Installation.

B. National Electrical Manufacturers Association (NEMA):
1. NEMA KS 1 - Enclosed Switches.

C. National Electrical Testing Association (NETA):
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association (NFPA):
1. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
1. Product Data:
a. Grounding electrodes and connections.
b. Starter electrical characteristics and connection requirements.

2. Assurance/Control Submittals:
   a. Electrical System Test Reports: Submit report including the following directly to USPS Project Manager from Testing Laboratory, with copy to Contractor. Prepare reports in conformance with Section 014000 - Quality Requirements.
      1) Summary of project.
      2) Description of equipment tested.
      3) Description of test.
      4) Test results.
      5) Conclusions and recommendations.
      6) Appendix, including appropriate test forms.
      7) List of test equipment used and calibration date.
      8) Signature of responsible Testing Laboratory Officer.
   b. Certificates: Manufacturer's certificate that each Product specified meet or exceed specified requirements.
   c. Qualification Documentation: Submit documentation of experience indication compliance with specified qualification requirements.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
   1. Project Record Documents: Accurately record the following.
      a. Locations of components and grounding electrodes.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing Work of this Section with minimum 5 years documented experience.

B. Regulatory Requirements:
   1. Products: Listed and classified by Underwriters Laboratories, Incorporated as suitable for the purpose specified and indicated.
   2. Work herein shall conform to all applicable laws, ordinances and regulations in accordance with the latest applicable requirements of:
      a. National Electrical Manufacturer’s Associates.
      b. Standards of National Fire Protection Association (NFPA 72, 90A and 101).
      c. Underwriter’s Laboratories.
      d. Occupational Safety and Health Agency Standards.
      e. Illuminating Engineering Society Handbook.
      f. The International Existing Building Code.
      g. The International Electrical Code.
      h. ASHRAE Standard 90.1.
      i. The International Energy Conservation Code.

1.5 BASIC ELECTRICAL METHODS

A. Drawings are schematic and diagrammatic. Use judgment and care to install electrical Work to function properly and fit within building construction and finishes. Electrical conductors, conduit, components, not shown or specified, which are required for any device or system to produce a complete and operative system are required to be furnished and installed.

B. Exact location of outlets are determined from dimension on Drawings, manufacturer's shop drawings, or as may be determined at Project Site. Do not scale Drawings for exact location of any item. Verify item mounting heights as required by project conditions prior to rough-in.

C. Route conduits and wiring associated with new equipment and systems above ceilings, in existing chases, and concealed within building structure.

D. Surface mounted raceways or conduit permitted only at locations indicated on Drawings.

E. Circuit grouping, conduit or cable runs and home runs are indicated with number of conductors shown in each raceway to clarify operation and function of various systems. Provide proper number of conductors and conduits or cables to provide operative system as indicated on Contract Documents. Do not regroup any feeder circuits, branch circuits, home runs, and zone alarms at any point, from that shown on Contract Documents. Each conduit run shall contain no more than (6) current carrying conductors.

F. Branch and home run circuits are indicated as 2, 3, or 4 wire circuits unless otherwise noted. Do not connect two ungrounded conductors to same circuit breaker/fused switch in any panel. Circuit runs consist of a maximum of five conductors; 3 phase conductors, 1 neutral conductor, and 1 equipment ground conductor, unless otherwise noted. Do not splice branch circuit conductors in any panels, safety switches, or circuit breakers in separate enclosures.

G. The sharing of neutral conductors for multiwire branch circuits is prohibited. All branch circuits shall contain individual neutrals.

H. Proposed equipment, switches or devices, shown mounted on and/or adjacent to equipment, which if installed, would impair proper operation of existing or new equipment, shall be removed and relocated by Contractor as required so equipment will function properly. Notify USPS Project Manager immediately if any such condition exists.

I. Seal and make permanently watertight penetrations by electrical raceways or equipment through ceilings, walls or floors.
   1. Seal penetrations in non-fire rated ceilings, walls or floors material specified in Section 079200 – Joint Sealants.
   2. Seal penetrations in fire rated walls with material specified in Section 078400 - Firestopping.

J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A, and NFPA 70.

K. Install equipment and materials to provide required maintenance and code working clearance for servicing and maintenance. Coordinate final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow required space for removal of parts that require replacement or servicing.

L. Remove existing equipment, lighting fixtures, switches, and receptacles as required to facilitate proposed installation and as specified in Section 024119 - Selective Structure Demolition. Remove existing wiring and conduit serving items to be removed. Conduit in inaccessible areas shall be cut off below finished surfaces and existing surface patched to match existing. Provide blank plates on existing flush mounted outlet boxes that will be abandoned. Remove all abandoned conductors from raceways.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING

A. Electrode Conductor:
   1. Material: Bare stranded copper.
   2. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

2.2 HANGERS AND SUPPORTS

A. Product Requirements: Furnish and install approved materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and conduit, including weight of wire in conduit plus 300 pounds.

B. Materials and Finishes: Corrosion resistive.

C. Anchors and Fasteners:
   1. Steel Structural Elements: Beam clamps and welded fasteners.
   2. Concrete Surfaces: Self-drilling anchors and expansion anchors.
   3. Hollow Masonry, Plaster, and Gypsum Board Partitions: Toggle bolts and hollow wall fasteners.
   4. Solid Masonry Walls: Expansion anchors.
   5. Sheet Metal: Sheet metal screws.
   6. Wood: Wood screws.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates:
   1. Engraved three-layer laminated phenolic plastic, white letters on black background.
   2. Locations:
      a. Each electrical distribution and control equipment enclosure.
      b. Communication cabinets.
      c. Terminal Cabinets.
      d. Individual motor starter.
      e. Separately enclosed circuit breakers.
      f. Panelboards
      g. Transformers.
      h. Pull boxes.
      i. Lighting contactor/control panel enclosure.
      j. Relays.
      k. Switches and disconnects.
   3. Letter Size:
      a. Use 1/8 inch letters for identifying individual equipment and loads.
      b. Use 1/4 inch letters for identifying grouped equipment and loads.

B. Wire and Cable Markers:
   1. Description: Cloth tape or tubing type wire markers.
   2. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
   3. Identification:
      a. Power and Lighting Circuits: Branch circuit or feeder number indicated on Drawings.
      b. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on Drawings.
      c. Communications Cable: Per section 270500.

C. Conduit Markers:
   1. Underground conduit routings shall be marked utilizing magnetic marker tape set atop of the entire conduit run.
      a. Underground-Type Plastic Line Marker: Manufacturer’s standard detectable permanent, bright colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6” wide by 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable. Locate tape 12 inches above top of conduit.

D. Arc Flash warning Signs: Furnish signs in accordance with NEC Article 110.16, warning of potential arc flash hazard and requiring suitable Personal protective equipment. Locate and install signs per INSTALLATION Section of this specification.

E. Receptacles and Switches: All coverplates for receptacles and switches shall be labeled with the branch circuit number. Label shall be machine generated and permanently affixed to the outside of the coverplate.

2.4 MOTOR STARTERS, CONTROLS, AND CONNECTIONS TO MECHANICAL EQUIPMENT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
   1. Allen-Bradley Company, Milwaukee, WI (414) 382-2000.
   2. Cutler-Hammer Eaton Corp, Milwaukee, WI (800) 833-3927.
   3. Square D Company, Palatine, IL (847) 397-2600.
   4. General Electric Company, Plainville, CT (860) 747-7111.
   5. Siemens Energy and Automation, Alpharetta, GA (800) 964-4114.
   6. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Motor Starters:
   1. Provide manual, single phase, 120/277V, toggle type, motor rated switches with thermal overload element (sized at 115 percent of full load current) for fractional horsepower motors not requiring automatic control interfaces.
   2. Provide across-the-line, AC magnetic motor starters in applications where controls other than manual on and off are involved. Motor starters shall be UL labeled. Provide starters with the following features:
      a. Rating for the voltage and current imposed.
      b. Enclosure for the application usage: NEMA 1 for dry, indoors, NEMA 3R for outdoors, etc.
      c. Control circuit voltage and amperage to match coil voltage and ratings of control apparatus.
      d. Control transformers with primary and secondary fusing for control circuits, as required.
      e. Overload elements for every conductor leg above ground. Elements are to be “thermal alloy” type, resettable and properly sized to motor nameplate rating. Elements located near boilers, heat strips, duct heaters or other heat sources or where heating by conduction or radiation can occur, shall be ambient temperature compensated types.
      f. Adjustable phase loss/phase reversal protection (0-15 seconds), factory set at 7 seconds and a minimum of two field convertible auxiliary contacts.
      g. Cover-mounted control switch is to be a “start-stop” or “hand-off-auto” type with “running” and “auto” pilot lights, as required by the control sequence. A suitable reset device for manually resetting overcurrent trip shall be provided.
   3. Magnetic starters for motors 10 hp or less shall be connected to automatically return the motor to service after a power interruption. Starters for motors over 10 hp shall be equipped with time delay relays so that after a power resumption and after a preset delay of 0-30 seconds, the motor shall automatically be returned to service.
   4. Combination magnetic motor starter/fused disconnect unit shall be utilized wherever possible.

C. Furnish and Install the Following:
   1. Conduit, wiring and electrical connections to motors, safety switches, starters, relays, electrical interlock circuits, valves, unit heaters, fan coil units, air handling units, and other similar equipment, required for complete and ready for operation. Coordinate with and review other sections of the specifications describing electrical equipment in order to fully understand the wiring requirements.
   2. Starters as indicated on Drawings except factory provided starters such as those physically mounted on the unit or any piece of equipment where starter is furnished as an integral part of the equipment.
   3. Electrical line voltage control components and installation as specified in Division 26 Sections.

4. Furnish and install low voltage (below 50 volts) control wiring as indicated on Drawings using metallic conduit and No. 12 type THHN wire, minimum.
5. Thermostat and special wire other than building wire.

D. Refer to Drawings for quantity and size of motor starters.

E. Individual motor starters and those starters factory provided integral with the equipment shall be furnished in accordance with paragraph 2.4 B.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to USPS Project Manager prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION - GROUNDING AND BONDING

A. Provide bonding and grounding in conformance with NFPA 70.

B. Equipment Grounding Conductor: Provide separate, insulated conductor within all lighting and power raceways. Terminate each end on suitable lug, bus, or bushing.

C. Testing and Inspection:
1. Inspect and test in accordance with NETA ATS, where applicable.
2. Perform inspections and tests listed in NETA ATS, Section 7.13.
3. Test ground resistance of system with clamp-on ground resistance tester. The resistance of the grounding system shall not exceed 5 ohms. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; lengthening the rods or installing ground enhancing materials; then retest to demonstrate compliance. Install rods at least 8 feet apart.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Install products in accordance with manufacturer's published instructions.

B. Furnish and install anchors, fasteners, and supports in accordance with NECA SI.

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

D. Do not use spring steel clips and clamps.

E. Do not use powder-actuated anchors.

F. Obtain permission from structural engineer before drilling or cutting structural members.

G. Fabricate supports from structural steel angle or structural steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

I. In wet and damp locations use structural steel channel supports to stand cabinets and panelboards one inch off wall.

J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

3.4 INSTALLATION - ELECTRICAL IDENTIFICATION

A. Install nameplate parallel to equipment lines.

B. Secure nameplate to equipment front using stainless steel screws. Use minimum two screws at each end of nameplate.

C. Secure nameplate to outside surface of door on panelboards and switchboards.

D. Install Arc Flash Warning Signs on switchboards, panelboards, control panels, meter socket enclosures, and motor control centers likely to require examination, adjustment, servicing, or maintenance while energized. Locate sign so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

3.5 INSTALLATION – MOTOR STARTERS. CONTROLS, AND CONNECTIONS TO MECHANICAL EQUIPMENT

A. Verify and check equipment manufacturer's nameplate and installation instructions to obtain exact location of outlets for equipment before installation.

B. Wire and connect line voltage controls in accordance with approved wiring diagrams. Provide line voltage interlock and control wiring as indicated on Drawings using conduit and No. 12 type THHN wire.

3.6 FIELD QUALITY CONTROL - ELECTRICAL TESTING AND INSPECTION

A. Section 014000 - Quality Requirements: Field testing and inspection.

B. Section 260800 - Commissioning of Electrical Systems: Requirements related to Division 26 Commissioning.

C. Conduct testing to Determine that Electrical Equipment and Systems:
   1. Are in conformance with Contract Documents and applicable reference standards.
   2. Is properly installed without damage due either to installation or shipment.
   3. Operate correctly, meet design intent, and are performing at optimum level, in safe manner.

D. Provide a complete written record of operational values to be used as a baseline for future operational testing.

E. Instrumentation:
   1. Provide calibration program that assures applicable test instrumentation is maintained within rated accuracy and directly traceable to National Bureau of Standards.
   2. Calibrate instruments in accordance with following frequency schedule:
      a. Field Instruments:
         1) Analog - 6 months maximum.
         2) Digital - 12 months maximum.
      b. Leased Specialty Equipment: 12 months. (Where accuracy is guaranteed by lessor.)
   3. Dated Calibration Labels: Visible on test equipment.
   4. Keep records current; show date and result of instruments calibrated or tested.
   5. Maintain current instrument calibration instruction and procedure for each test instrument.
   6. Calibrating Standard: Higher accuracy than that of instrument being calibrated.

F. Regulatory Requirements:
   1. Safety Practices: Include, but not limited to, the following requirements:
      a. Occupational Safety and Health Act of 1970 - OSHA.
      b. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
      c. Applicable State and Local Safety Operating Procedures.
      d. NETA Safety/Accident Prevention Program.
      e. United States Postal Service Safety Practices.
      f. NFPA 70E - Electrical Safety Requirements for Employee Workplace.
      g. American National Standards for Personnel Protection, ANSI Z244.1.
   2. Perform tests with apparatus de-energized except where otherwise specifically required herein.
   3. Testing Laboratory: Provide a designated safety representative present at Project Site and supervise safety operations.
   4. Power Circuits: Conductors shorted to ground by a hot line grounded device approved for the purpose.
   5. Do not proceed until safety representative has determined that it is safe to do so.
   6. Testing Laboratory: Provide sufficient protective barriers and warning signs to conduct specified tests safely.

G. Tests and inspections include, but are not limited to the following:
   1. Proper operation of lights and equipment.
   2. Continuity of raceway system.
   3. Insulation leakage and impedances.
   4. Ground system resistance.
   5. Elimination of reverse rotation and single-phasing of motors.
   6. Sub-system tests indicated in other Sections.
   7. Proper operation of fire alarm system specified in Section 283100.

H. Load balance all electrical phases, at device, panels, and switchboards.

I. Perform electrical system testing and inspection as specified in each related Section and as specified in this Section.

END OF SECTION

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building wire and cable.
   2. Branch-circuit cable.
   3. Wiring connectors and connections.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections
   1. As specified in Section 260500 - Common Work Results for Electrical.

1.2 REFERENCES

A. As specified in Section 260500 - Common Work Results for Electrical.

1.3 SUBMITTALS

A. As specified in Section 260500 - Common Work Results for Electrical.

1.4 QUALITY ASSURANCE

A. As specified in Section 260500 - Common Work Results for Electrical.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect products.

B. Deliver in accordance with NEMA WC 26.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
   1. Alcan Cable, Atlanta, GA (770) 392-2376.
   2. Anixter, Inc., Skokie, IL (800) ANIXTER.
   3. General Cable, Highland Heights, KY (800) 526-4391.
   4. General Electric, Plainville, CT (860) 747-7111.

5. Okonite, Ramsey, NJ (201) 825-0300.
6. Southwire Company, Carrollton, GA (800) 444-1700.
7. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Description: Single conductor insulated wire.

C. Conductor: Copper, except conductors #1/0 AWG and larger may be compact stranded aluminum if equipped with compression lugs and installed per manufacturer's recommendations and the National Electrical Code.

D. Insulation Voltage Rating: 600 Volts.

E. Insulation: NFPA 70, Type THHN/THWN or Type XHHW-2

F. Multiconductor cable: Metal clad cable, Type MC with ground wire.
1. Type "MC" cable shall be permitted for use in exposed or accessible ceiling spaces only. Type "MC" cable shall not be utilized above inaccessible hard ceilings or in damp locations. Cable shall be supported and secured where such support does not exceed 3 ft. intervals and shall be properly color coded to identify phase, neutral, ground and switch legs.

2.2 WIRING CONNECTORS

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
1. Buchanan Construction Products, Hackettstown, NJ (800) 610-5201.
2. Thomas and Betts, Memphis, TN (800) 695-1901.
3. 3M, St. Paul, MN (800) 364-3577.
4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Compression Connectors; Conductor sizes #12 through #6 AWG:
1. Buchanan: 2006S or 2011S.
2. Thomas and Betts
3. 3M

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 260500 - Common Work Results for Electrical.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Wiring methods
1. Concealed Dry Interior Locations: Use building wire, Type THHN/THWN or Type XHHW-2 insulation in metallic raceway or MC multiconductor cable.

2. Exposed Dry Interior Locations: Use building wire, Type THHN/THWN or Type XHHW-2 insulation in metallic raceway or MC multiconductor cable.
3. Above Accessible Ceilings: Use building wire, Type THHN/THWN or Type XHHW-2 insulation in metallic raceway or MC multiconductor cable.
4. Wet or Damp Interior/Exterior Locations: Use only building wire, Type THHN/THWN or Type XHHW-2 insulation in raceway.

B. Install products in accordance with manufacturers published instructions and NECA SI.

C. Use solid conductor for feeders and branch circuits 10 AWG and smaller.

D. Use stranded conductors for control circuits and final connections to all vibration equipment.

E. Use conductor not smaller than 12 AWG for power and lighting circuits.

F. Use conductor not smaller than 14 AWG for control circuits.

G. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

H. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

I. Pull all conductors into raceway at same time.

J. Use approved wire pulling lubricant for all building wire.

K. Protect exposed cable from damage.

L. Neatly train and lace wiring inside boxes, equipment, and panelboards in accordance with NECA Standards.

M. Clean conductor surfaces before installing lugs and connectors.

N. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

O. For splices and taps, use only compression connectors for copper conductors, 6 AWG and larger or aluminum conductors 1/0 and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

P. Use solderless pressure compression connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

Q. Use conductors rated 90 degrees C, inside a ballast compartment or within 6 inches of any ballast.

R. Conductor Sizes #8 and Larger: Class B stranding.

S. The sharing of neutral conductors for multiwire branch circuits is prohibited. All branch circuits shall contain individual neutral conductors.

3.4 CONSTRUCTION

A. Interface with Other Work:
1. Identify wire and cable using Thomas and Betts type WM vinyl markers.
2. Identify each conductor with its circuit number or other designation indicated on Drawings in all junction, pull, terminal boxes and cabinets. Identify neutrals with common circuit numbers in all junction, pull and terminal boxes, panels and cabinets.

3.5 WIRING COLOR CODE

A. Comply with the following color code for each voltage system.

B. 208Y/120 Volt System:
   1. Phase A - Black
   2. Phase B - Red
   3. Phase C - Blue.
   4. Neutral - White.
   5. Equipment Ground - Green.

C. 240/120 Volt System:
   1. Phase A - Black.
   2. Phase B - Red
   3. Neutral - White.
   4. Equipment Ground - Green.

D. Use same color for same phase throughout. Use same colors for switch legs. Travelers shall be yellow. Phase rotation shall be same in all panels. Identify large cables with colored tape.

E. Provide identification tags on each conductor entering panel, switch, junction box and pull box to identify conductor.

3.6 FIELD QUALITY CONTROL

A. As specified in Section 260500 – Common Work Results for Electrical.

B. Cables, 600 Volt or less and size no. 3 or larger, shall be meggered using an industry-approved “megger with a minimum of 500 Volt internal generating voltage. All inspection, cleaning and testing procedures shall be in compliance with the recommendations and standards outlined in the “maintenance testing specifications for electrical power distribution equipment and systems”, latest edition, published by International Electrical Testing Association (NETA). Insulation resistance test values shall be no less than 250 megaohms. A typewritten report of all readings shall be prepared and submitted.

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduit.
2. Flexible metal conduit.
3. Liquidtight metal conduit.
4. Electrical metallic tubing.
5. Fittings and conduit bodies.
6. Wall and ceiling outlet boxes.
7. Pull and junction boxes.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections:
1. Section 283100 – Fire Detection and Alarm System (Horn/Strobes).
2. Section 230500 – Common Work Results for HVAC.
3. Section 260500 – Common Work Results for Electrical.
4. Section 262726 – Wiring Devices.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM A 123 - Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.

B. American National Standards Institute (ANSI):
1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
3. ANSI C80.5 - Rigid Aluminum Conduit.

C. National Electrical Contractors Association (NECA):
1. NECA "Standard of Installation."

D. National Electrical Manufacturers Association (NEMA):
1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
2. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
3. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
4. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
5. NEMA VE 1 - Metallic Cable Tray Systems.

E. National Fire Protection Association (NFPA):
1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

A. Design Requirements
   1. Conduit Size: NFPA 70, unless indicated otherwise on Drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Conform to requirements of NFPA 70.
   2. Provide products listed and classified by Underwriters Laboratories, Incorporated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Transport, handle, store, and protect products.

B. Accept conduit on site. Contractor inspect for damage prior to acceptance.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Where conduit is required by standards, codes, or required elsewhere, minimum size shall be as follows:
   1. 1/2 inch for power and branch circuit wiring, unless indicated otherwise. All homerun conduits shall be 3/4 inch, minimum.
   2. 3/4 inch for communications cable, unless indicated otherwise.
   3. 3/4 inch for low voltage, control, intercom, security and communications unless indicated otherwise.

2.2 METAL CONDUIT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Allied Tube & Conduit, Harvey, IL (800) 882-5543.
   2. Wheatland Tube Co., Collinswood, NJ (800) 257-8182.
   3. Republic Wire & Cable, Rocky Mount, NC (800) 533-8198.
   4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Rigid Galvanized Steel Conduit (GRC): ANSI C80.1, UL6.

C. Intermediate Metal Conduit (IMC): UL1242.

D. Fittings and Conduit Bodies: NEMA FB1 Material to match conduit.

2.3 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Hubbell, Millford, CT (203) 882-4800.
   2. Electriflex, Roselle, IL (800) 323-6174.
   3. 0-Z/Gedney, Farmington, CT (860) 677-5541.
   4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Description: Interlocked steel and aluminum construction.

C. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Hubbell, Millford, CT (203) 882-4800.
   2. Electriflex, Roselle, IL (800) 323-6174.
   3. Anixter, Inc., Skokie, IL (800) ANIXTER.
   4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Description: Interlocked steel and aluminum construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Allied Tube & Conduit, Harvey, IL (800) 882-5543.
   2. Wheatland Tube Co., Collinswood, NJ (800) 257-8182.
   3. Republic Wire & Cable, Rocky Mount, NC (800) 533-8198.
   4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel set-screw type. Die-cut Zinc not permitted.

2.6 NONMETALLIC CONDUIT

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Carlon, Cleveland, OH (800) 322-7566.
   2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Description: NEMA TC 2; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 FITTINGS

A. Manufacturer: Raco, Inc., South Bend, IN (219) 234-7151.
   1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
      a. Steel City.
      b. 0-Z/Gedney.
   2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Conduits 1/2 inch thru 1 inch enter junction boxes, pull boxes, panels, cabinets, and gutters, provide the following:
   1. Rigid Conduit: Raco 1222, 1223, 1224.
   2. Flexible Metal Conduit: Raco 3302, 3303, 3304, 3305, 3306, 3308.
   3. Liquidtight Flexible Metal Conduit: Raco 3511, 3512, 3513, 3541, 3542, 3543.

C. Conduits 1-1/4 inch and larger entering junction boxes, pull boxes, panels, cabinets, and gutters, provide Insulated throat type bushings; Raco 1225, 1226, 1228, 1230, 1232, 1234, 1236.

D. Provide threaded joint connectors and malleable iron no thread compression box connectors on rigid conduit. Do not provide fittings requiring set screws or indentor type applications including BM connectors.

E. Provide only steel set-screw couplings and connectors on EMT conduit.

2.8 CONDUIT STRAPS AND HANGERS

A. Strap Manufacturer: Raco, Inc., South Bend, IN (219) 234-7151
   1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
      a. Steel City.
      b. Unistrut.
   2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Hanger Manufacturer: Steel City/Thomas & Betts, Memphis, TN (800) 888-0211.
   1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
      a. Unistrut.
      b. Raco.
   2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

C. Straps: Two hole push on stamped steel straps on surface areas such as concrete, masonry, wide flange beams, columns, and wood.
   1. Rigid Conduit: Raco 2232, 2233, 2234, 2235, 2336, 2238.
   2. Electrical Metallic Tubing: Raco 2092, 2093, 2094.

D. Hangers: Lay-in pipe hanger.
   1. Conduits 1-1/4 Inch and Larger: Steel-City C-149.

E. Trapeze Hangers for Conduits Grouped Together: Hangers consisting of all thread rods sized as required and Kingdorff channel.
   1. Steel City B-909, 1/2 inch x 1-7/8 inch (12 gauge) with single bolt channel pipe straps.
   2. Steel City C-105, C-105-AL, or C-106, (no wire permitted for anchoring conduit).

2.9 SEAL-OFF AND EXPANSION FITTINGS

A. Seal-Off Fitting Manufacturer: Crouse-Hinds, Syracuse, NY (315) 477-5531.
   1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
      a. Killark.
      b. Appleton.
      c. O-Z/Gedney.
   2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Expansion Fitting Manufacturer: OZ/Gedney, Farmington, CT (860) 677-5541
   1. Subject to compliance with project requirements, one of the following manufacturers may also be provided:
      a. Crouse-Hinds.
      b. Killark.
      c. Appleton.
   2. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

C. Provide seal-off fittings where required by governing authority, code, or as indicated on Drawings.
   1. Vertical Runs: Crouse-Hinds Type EYS.
   2. Horizontal and Vertical Runs: Crouse-Hinds Type EZS.
   3. Elbows: Crouse-Hinds Type EYS.
   4. Sealing Compound: "Chico X" fiber and "Chico A".

D. Provide expansion fittings in conduits where indicated on Drawings or where required to pass through expansion joints embedded in concrete.
   1. O-Z/Gedney Type AX.

2.10 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
   2. Receptacle and Device Boxes - 4 inch square x 2-1/8 inch deep with raised, single gang, plaster ring unless indicated otherwise.
   3. Switch Boxes: 2 inch x 4 inch x 2-1/8 inch deep, unless indicated otherwise.
   4. Communication Boxes: 4 inch square x 3 inch deep with raised gang plaster ring unless indicated otherwise.

B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

C. Wall Plates for Finished Areas: Specified in Section 262726.

2.11 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify routing and termination locations of conduit prior to rough-in.

C. Report in writing to the USPS Project Manager prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION - RACEWAYS

A. Install in accordance with the following schedule, unless indicated otherwise on Drawings: Plastic flexible PVC conduit shall not be permitted. Flexible metal conduit shall be permitted for electrical power and security wiring only and not permitted for fire alarm cables. Intermediate grade rigid conduit permitted where indicated below.
   1. Above suspended ceilings: Galvanized or sherardised thick wall rigid steel (GRC), or intermediate grade rigid steel (IMC), or electrical metallic tubing (EMT).
   2. Metal stud walls: Galvanized or sherardised thick wall rigid steel (GRC), intermediate grade rigid steel (IMC), or electrical metallic tubing (EMT).
   3. Exposed interior areas: Galvanized or sherardised thick wall rigid steel (GRC), intermediate grade rigid steel (IMC), electrical metallic tubing (EMT).
   4. Exposed exterior areas: Galvanized or sherardised thick wall rigid steel (GRC).
   5. Underground or below slab areas: Rigid polyvinyl chloride conduit (PVC-Sched. 40).

B. Install conduit in accordance with NECA "Standard of Installation."

C. Install nonmetallic conduit in accordance with manufacturer's instructions. Nonmetallic conduit shall only be used under slabs or direct buried in earth. Conduit penetrations through slab including elbows shall be galvanized rigid conduit.

D. Conduit routing indicated on Drawings are approximate locations unless dimensioned. Route parallel and perpendicular to building construction for complete wiring system regardless whether exposed or concealed.

E. Arrange supports to prevent misalignment during wiring installation.

F. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

G. Group related conduits; support using conduit rack. Construct rack using approved steel channel and provide space on each rack for 25 percent additional conduits.

H. Fasten conduit supports to building structure and surfaces under provisions of this section.

I. Do not support conduit with wire or perforated pipe straps in any type structure. Remove wire used for temporary supports. Steel tie wire may be used to anchor conduit down to reinforcing rods in concrete encasement only.

J. Do not attach conduit or boxes to ceiling support wires. Boxes shall be independently supported.

K. Arrange conduit to maintain headroom and present neat appearance. Maintain required clearance between conduit and piping.

L. Route all conduit, whether exposed or concealed, parallel and perpendicular to walls, ceilings, building structures, etc.

M. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

N. Cut EMT conduit square using saw or pipe cutter; de-burr cut ends and ream. Bring conduit to shoulder of fittings; fasten securely.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

P. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. Use Myers hub connectors on all conduit entering top or sides of all junction boxes, pull boxes, wiring gutters, exposed to weather.

Q. The number of conduit bends per box shall comply with NFPA 70, Article 360. Conduit bends for “SCS” installation shall not exceed two 90 degree bends or exceed a total of 180 degrees of bend between pull boxes or conduit ends. Pull boxes shall be sized per NEC codes per conduit installed. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or use factory elbows for bends in metal conduit larger than 2 inch size.

R. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

S. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.

T. Provide suitable nylon pull string or #14 AWG steel wire in each conduit excluding sleeves and nipples.

U. Ground and bond conduit per NFPA 70.

V. Coat all metallic conduit with "General Electric" RTV silicone sealer where conduit is installed in exterior areas or in contact with concrete or earth.

W. Conduits shall be sized as indicated on Drawings. Where sizes are not indicated, conduit shall be sized per NFPA 70.

X. Cap all upturned conduits during construction rough-in to prevent moisture or debris from entering. Pull through each and every conduit a dry swab of sufficient size to remove any and all moisture.

Y. Maximum length of flexible metal conduit (Greenfield), or flexible liquidtite shall be 5 feet.

Z. Assure ground continuity on all branch circuitry conduits with two locknuts, one inside and one outside of all boxes, cabinets and gutters for rigid conduit. One locknut inside of all boxes, cabinets, and gutters for EMT.

AA. Provide conduit supports as follows:
1. Galvanized rigid thick wall conduit (GRC), intermediate grade rigid conduit (IMC) and electrical metallic conduit (EMT) within three feet of all outlet boxes, junction boxes, cabinets, gutters, or fittings. Horizontally anchored at 10 foot maximum intervals. Other spacings indicated on Drawings.

2. Flexible metal conduit (Greenfield) and liquid-tight flexible metal conduit (sealtite), within 12 inches of all outlet boxes, junction boxes, cabinets, gutters, or fittings and bends or turns. Horizontally anchored at 4-1/2 foot intervals. 1/2 inch minimum size permitted.

3.3 INSTALLATION - BOXES

A. Install boxes in accordance with NECA "Standard of Installation."

B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with NFPA 70.

C. Set wall mounted boxes at elevations to accommodate mounting heights indicated or as required for specific project requirements. Orient boxes to accommodate wiring devices as specified in Section 262726.

D. Electrical boxes are indicated on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose with no additional cost to contract. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

E. Maintain headroom and present neat mechanical appearance.

F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Install pull boxes in freezer and dock area above bottom chord of structural joist. Pullboxes sized in excess of 12 inches shall be equipped with hinged and hasped covers.

G. Install outlet and junction boxes within inaccessible ceiling areas, no more than 6 inches from ceiling access panel or from removable recessed luminaire.

H. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.

I. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

J. Locate flush mounted box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. Use approved raised gang covers in masonry and stud walls.

K. Flush mounted boxes shall not be mounted back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.

L. Secure flush mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Use approved stamped steel bridges to fasten box between studs.

M. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

N. Use approved adjustable steel channel fasteners spanning joist for hung ceiling outlet box.

O. Provide factory sectioned multi-gang boxes where more than one adjacent device is to be mounted. Sectional boxes shall not be permitted.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspection.

B. Inspect conduit installation, types, sizes, fittings and attachment to structure.

C. Inspect box installation, locations, connection to conduit, and attachment to structure.

D. Inspect cable tray installation, locations, connection to conduit, and attachment to structure.

3.5 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

3.6 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish like new.

END OF SECTION

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Panelboards.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections:
   1. As specified in Section 260500 - Common Work Results for Electrical.

1.2 REFERENCES

A. As specified in Section 260500 - Common Work Results for Electrical.

B. National Electrical Manufacturers Association (NEMA):
   1. NEMA AB 1 – Molded Case Circuit Breakers.
   2. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies.
   3. NEMA KS 1 – Enclosed Switches.
   4. NEMA PB 1 – Panelboards.
   5. NEMA PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

C. Underwriters Laboratories (UL):
   1. UL 486 – Molded Case Circuit Breakers.
   2. UL 67 – Heat Rise Test for Panelboards.
   3. UL 50 – Steel Gauge Requirements for Cabinets and Enclosures.
   4. UL 1449 4th Edition – Standard for Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. As specified in Section 260500 – Common Work Results for Electrical.
   1. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
   2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
   3. Shall include UL 1449 Listing documentation verifying the following:
      a. Short Circuit Current Rating (SCCR)
      b. Voltage Protection Ratings (VPRs) for all modes
      c. Maximum Continuous Operating Voltage Rating (MCOV)
      d. I-nominal rating (I-n)

B. Section 017704 – Closeout Procedures and Training: Procedures for closeout submittals:

1. Project Record Documents: Record actual locations of Products; indicate actual branch circuit arrangement.
2. Operation and Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
3. Submit data showing compliance with UL 1449.

1.4 QUALITY ASSURANCE

A. As specified in Section 260500 – Common Work Results for Electrical.

B. Panelboards shall be UL Listed and labeled and shall be designed in accordance with the applicable standards of ANSI and NEMA.

C. Qualifications
1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

PART 2 - PRODUCTS

2.1 GENERAL CLASSIFICATION

A. Manufacturers: General Electric Company (G.E.) Catalog numbers are used to identify type of equipment specified. Equivalent products by the following manufacturers are acceptable: Alternate substitutions not permitted.
1. Siemens
2. Square-D
3. Eaton/Cutler Hammer
   a. Branch Circuit Panels:
      1) 120/208V: G.E. Type AQ
   b. Distribution Panels:
      1) Circuit breaker: G.E. Type CS or A
4. No Substitutions permitted.

2.2 PANELBOARDS

A. Cabinet: Construct cabinet with code gauge galvanized steel. Provide minimum 20 inch wide cabinets, and extra wiring space where incoming feed-through or parallel lines are required.

B. Doors: Provide single door construction, made of cold-rolled steel. Door shall have concealed hinges, flush catch, and lock. (Tie bar handles not acceptable). Secure top and bottom of door to cabinet by slotted steel bolts. Release shall be by one-half turn with a screwdriver. All panels shall be keyed alike.

C. Panels located adjacent to each other shall have identically sized enclosures and trims.

D. Finish: Finish exposed parts with one coat of primer and one coat of light gray enamel suitable for overpainting in field if desired.

E. Phase, neutral and ground bus bars shall be tin plated copper.

F. Provide all hardware for future breakers, identified on drawings as SPACES, or for the full length of usable bus, whichever is longer.

G. Provide ground bus with full complement of terminals in addition to insulated neutral bus.

H. Circuit Breakers:
   1. Provide multi-pole units with common trip elements. Handle ties are not acceptable.
   2. Provide key-operated circuit breakers in the panelboards used for the Fire Alarm. Circuit breakers shall be similar to square D type QO_K.
   3. 120/208V branch circuit panelboards: Molded cast bolt-on type designed for 120/208V, three phase, four wire service with minimum 10,000 amperes rms short circuit rating.

I. Main circuit breakers shall be individually mounted. The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the main shall have barriers.

J. Provide all panelboards with lockout/tagout devices; Circuit-Safe type as manufactured by Stranco, Inc. or approved equal.

K. Nameplates: Provide screwed-on (no adhesives) engraved bakelite nameplate identification on outside of each panel showing panel designation, voltage and phase in minimum ¼ inch high letters.

L. Circuit directories: Provide a metal-framed typewritten circuit directory on inside of inner door, with plastic protector.

M. Provide 2-3/4 inches and 1-1 inch spare empty conduits routed above into accessible ceiling space from all flush mounted panelboards.

N. Panels serving electronic equipment and/or other harmonic producing loads shall be equipped with double neutral bus bars.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 260500 – Common Work Results for Electrical.

3.2 CLEARANCES

A. Minimum code required clearances around panelboards must be maintained.

3.3 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb. Provide supports in accordance with Section 260500.

C. Provide filler plates for unused spaces in panelboards.

3.4 MOUNTING HEIGHT

A. Typically mount panel boards top at 6 ft. – 0 in. above finished floor but no more than 6 ft. – 6 in. above finished floor to top of circuit breaker handle.

3.5 MOUNTING HARDWARE

A. Provide all necessary blocking, channels and other hardware for securing panelboards to wall, column, or other parts of building structure.

3.6 FIELD QUALITY CONTROL

A. As specified in Section 260500 – Common Work Results for Electrical.

B. Inspect and test panelboard installation and torque connections.

C. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

D. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall switches.
   2. Receptacles.
   3. Device plates and box covers.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections:
   1. As specified in Section 260500 - Common Work Results for Electrical.

1.2 REFERENCES

A. As specified in Section 260500 - Common Work Results for Electrical.

B. National Electrical Manufacturers Association (NEMA):
   1. NEMA WD 1 - General Requirements for Wiring Devices.
   2. NEMA WD 6 - Wiring Device -- Dimensional Requirements.

1.3 SUBMITTALS

A. Product data required.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

A. Regulatory Requirements:
   1. Conform to requirements of NFPA 70.
   2. Provide Products listed and classified by Underwriters Laboratories, Incorporated.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Hubbell, Inc, Milford, CT (203) 882-4800.
   2. Leviton Manufacturing, Company, Inc., Little Neck, NY (800) 824-3005.
   3. Pass & Seymour, Syracuse, NY (800) 776-4035.

B. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

C. Provide 20 Amp, 120/277V, specification grade, flush, single pole toggle switches with side and back wired screw terminals. All switches shall be equipped with grounding screws.

D. Single Pole Switch:
   1. Leviton Cat. No.1221-2.
   2. P&S Cat. No. PS20AC1I.
   3. Hubbell Cat. No. HBL1221.

E. Double Pole Switch:
   1. Leviton Cat. No. 1222-2.
   2. P&S Cat. No. PS20AC2.
   3. Hubbell, Cat. No. HBL1222.

F. Color: Switches shall be white unless indicated otherwise.

2.2 RECEPTACLES

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. Leviton Manufacturing, Company, Inc., Little Neck, NY (800) 824-3005.
   2. Pass & Seymour, Syracuse, NY (800) 776-4035.
   3. Hubbell, Inc, Milford, CT (203) 882-4800.
   4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Provide duplex, specification grade, 20 Amp, 120 Volt, 2 pole, 3 wire receptacles with grounding screw.

C. Duplex Convenience Receptacle:
   1. Leviton Cat. No. 5362.
   2. P&S Cat. No. 5362.
   3. Hubbell Cat. No. HBL5352.

D. Tamper and Weather Resistant GFCI Receptacle (Side Wired Feed-Thru):
   1. Hubbell Cat. No. GFR5362SG.

E. Color: Receptacles located within the Retail Area to be mounted in “blue” or “red” painted walls shall be black. All other receptacles shall be white unless indicated otherwise.

2.3 WALL PLATES

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering specified items which may be incorporated in the Work include the following:
   1. P&S Sierra.
   2. Hubbell.
   3. Leviton.

4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

B. Coverplate: Coverplates to be installed within the Retail Areas on “blue” or “red” painted walls shall be black smooth thermoplastic. All other coverplates shall be white smooth thermoplastic unless otherwise noted.
   1. Sierra TP8-W.

C. Weatherproof Coverplate: Gasketed cast metal with hinged gasketed device.
   1. Sierra 4510 cast aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
   1. Verify that outlet boxes are installed at proper height.
   2. Verify that wall openings are neatly cut and will be completely covered by wall plates.
   3. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install wiring devices as indicated, in accordance with manufacturer’s written instruction, applicable requirements of NEC and NECA "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on bottom.

E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

F. Connect wiring devices by wrapping conductor 2/3 of screw diameter in clockwise direction around screw terminal. Tighten screw to 12 pound-inches. Do not use spring pressure devices for wire connections.

G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

H. Provide coverplates on switch, receptacle, and blank outlets.

3.4 LABELING

A. All coverplates for receptacles and switches shall be labeled with the branch circuit number. Label shall be machine generated and permanently affixed to the outside of the coverplate.

3.5 CONSTRUCTION

A. Interface with other work:
   1. Coordinate locations of outlet boxes provided under Section 260533 to obtain mounting heights indicated on Drawings.

3.6 FIELD QUALITY CONTROL

A. Section 014000 – Quality Requirements: Field inspection.

B. Prior to energizing circuitry, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

C. Inspect each wiring device for defects.

D. Operate each wall switch with circuit energized and verify proper operation.

E. Verify that each receptacle device is energized.

F. Test each receptacle device for proper polarity.

G. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

A. Adjust devices and wall plates to be flush, level and plumb with wall.

3.8 CLEANING

A. Section 017300 Execution: Cleaning installed work.

B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Fuses.

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

C. Related Sections:
   1. As specified in Section 260500 - Common Work Results for Electrical.

1.2 REFERENCES

A. National Electrical Testing Association (NETA):
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Electrical Contractors Association (NECA):
   1. NECA SI - Standard of Installation.

C. National Electrical Manufacturers Association (NEMA):
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA KS 1 - Enclosed Switches.

D. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
   1. Product Data:
      a. Switch ratings and enclosure dimensions.
      b. Fuse data sheets showing electrical characteristics including time-current curves.
   2. Assurance/Control Submittals:
      a. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
      b. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
   1. Project Record Documents: Record actual locations of enclosed switches and actual fuse sizes.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with NECA SI.

B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.

C. Regulatory Requirements:
   1. Conform to requirements of NFPA 70.
   2. Products: Listed and classified by Underwriters Laboratories, Incorporated as suitable for purpose specified and indicated.

1.5 MAINTENANCE

A. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.

B. Extra Products: At completion of installation, deliver to USPS Project Manager.
   1. Three of each size and type fuse installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Switches: Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   1. Eaton/Cutler Hammer Corp., Pittsburg, PA (800) 525-2000.
   2. General Electric Company (800) 626-2000.
   3. Siemens Energy & Automation, Alpharetta, GA (800) 964-4114.
   4. Square D Company, Palatine, IL (800) 392-8781.

B. Fuses: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
   1. Cooper Industries Incorporated, Waukesha, WI (414) 524-3300.
   2. General Electric Company (800) 626-2000.
   3. Gould Shawmut, Newburyport, MA (508) 462-6662.

C. Section 016000 - Product Requirements: Product options and substitutions. Substitutions not permitted.

2.2 FUSIBLE ENCLOSED SWITCH ASSEMBLIES

A. NEMA KS 1, Type HD heavy duty, 100,000 AIC load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Cover shall be equipped with a manual defeat to allow opening by authorized personnel while energized. Handle shall be lockable in ON or OFF position.

B. Rating: 250 volts AC or 600 volts AC as indicated on Drawings.

C. Fuse Clips: Designed to accommodate Class R fuses.

D. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: NEMA Type 1 or 12.
   2. Exterior Locations: NEMA Type 3R or 12.

E. Provide factory grounding lug and neutral block if required.

2.3 NONFUSIBLE SWITCH ASSEMBLIES

A. NEMA KS 1, Type GD, general duty load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Cover shall be equipped with a manual defeat to allow opening by authorized personnel while energized. Handle shall be lockable in ON or OFF position.

B. Rating: 250 volts AC or 600 volts AC as indicated on Drawings.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: NEMA Type 1 or 12.
   2. Exterior Locations: NEMA Type 3R or 12.

D. Provide factory grounding lug and neutral block if required.

2.4 FUSES

A. NEMA FU 1, Class RK5, dual element, current limiting, time delay, 250 volt AC or 600 volt AC as indicated on Drawings.

B. Interrupting Rating: 100,000 rms amperes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 260500 – Common Work Results for Electrical.

3.2 INSTALLATION

A. Switches:
   1. Install in accordance with manufacturers published instructions and NECA SI.
   2. Install where indicated on Drawings, where required by equipment, and where required by NFPA 70.
   3. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

B. Fuses:
   1. Install fuses in fusible switches in accordance with manufacturer's published instructions, as indicated on Drawings, or as required by loading per NFPA 70.
   2. Install fuse with label oriented with manufacturer, type, and size easily read.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field testing and inspection.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 262923

VARIABLE SPEED DRIVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Variable Speed Drive System
   2. High efficiency electric motors

B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

C. Related Sections:
   1. Section 251304 - Facility System Integration into Enterprise Energy Mgmt System (EEMS).
   2. Section 260500 - Common Work Results for Electrical: Basic electrical methods.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE):
   1. IEEE 519-1992 - Harmonic Distortion Standard.

B. National Electrical Contractors Association (NECA):
   1. NECA SI - Standard of Installation.

C. National Electrical Manufacturers Association (NEMA):

D. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.
   1. Product Data:
      a. Product Specifications.
      b. Descriptive Bulletins
   2. Assurance/Control Submittals:
      a. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
      b. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

B. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.
   1. Project Record Documents: Record actual locations, ratings and sizes of variable speed drives.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Manufacturer's recommendations and as specified herein.

B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five years documented experience.

C. Regulatory Requirements:
   1. Conform to requirements of NFPA 70.
   2. Products: Listed and classified by Underwriters Laboratories, Incorporated as suitable for purpose specified and indicated.

1.5 MAINTENANCE

A. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.

B. Extra Products: At completion of installation, deliver to USPS Project Manager.
   1. Three of each size and type fuse installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Variable Speed Drives and Motors: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
   1. ABB, New Berlin WI, (414) 785-8605.
   2. Allen-Bradley, Milwaukee WI, (414) 382-2000.
   3. Cutler-Hammer Eaton Corp., Milwaukee WI, (800) 833-3927.
   4. Graham, Milwaukee WI, (414) 355-8800.
   5. MagneTek, La Vergne TN, (800) 624-6383.
   6. Reliance Electric, Rockwell Automation, Cleveland OH, (800) 241-2886.

B. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Not Permitted.

2.2 VARIABLE SPEED DRIVE EQUIPMENT (VSD):

A. Drive System shall be compatible with electrical characteristics of motors furnished and rated for operation with equipment furnished. **IMPORTANT NOTE:** Shaft grounding rings shall be incorporated into motors 10HP and higher to prevent electrically induced bearing damage (EIBD) when VFDs are utilized on larger pump and fan motors. Coordinate work with drive and equipment manufacturers.

B. System shall feature the following minimum operating characteristics:
   1. Input ac voltage tolerance of 240V, plus or minus 10 percent.
   2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
   3. Minimum Efficiency: 96 percent at 60 Hz, full load.
   4. Minimum Displacement Primary-Side Power Factor: 96 percent.
   5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   6. Starting Torque: 100 percent of rated torque or as indicated.
   7. Speed Regulation: Plus or minus 1 percent.

C. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
   1. Electrical Signal: 4 to 20 mA at 24 V.

D. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 2 to a minimum of 22 seconds.
   4. Deceleration: 2 to a minimum of 22 seconds.
   5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

E. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors.
   2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
   3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10 performance.
   4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   5. Instantaneous line-to-line and line-to-ground overcurrent trips.
   6. Loss-of-phase protection.
   7. Reverse-phase protection.
   8. Short-circuit protection.
   9. Motor overtemperature fault.

F. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

G. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

H. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

I. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

J. Minimum 5% line reactor.

K. The VSD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
   1. Power on.
   2. Run.
   3. Overvoltage.
   4. Line fault.
   5. Overcurrent.
   6. External fault.

M. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

N. Indicating Devices: Digital display and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
   1. Output frequency (Hz).
   2. Motor speed (rpm).
   3. Motor status (running, stop, fault).
   4. Motor current (amperes).
   5. Motor torque (percent).

6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

O. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
   a. 0 to 10-V dc.
   b. 0-20 or 4-20 mA.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.
   e. RS485.
   f. Keypad display for local hand operation
3. Output Signal Interface:
   a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
      1) Output frequency (Hz).
      2) Output current (load).
      3) DC-link voltage (VDC).
      4) Motor torque (percent).
      5) Motor speed (rpm).
      6) Set-point frequency (Hz).
4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
   a. Motor running.
   b. Set-point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high- or low-speed limits reached.

P. Communications Interface: Provide BACnet compliant MS/TCP interface to be used with an external system within a multidrop LAN configuration. Communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, acceleration/deceleration time adjustments, and lock and unlock the keypad. The interface shall allow monitoring of process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature, VSD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the communications interface.

Q. Manual bypass shall be provided for each VSD. VSD and bypass components shall be mounted inside a common NEMA 1 enclosure, fully pre-wired and ready for installation as a single UL listed device. Bypass shall include the following:
1. Input, output, and bypass contactors, to disconnect power to the VSD, when the motor is running in the bypass mode.
2. 115 V.A.C. control transformer, with fused primary.
3. Thermal overload relay, to protect the motor while operating in the bypass mode.
4. Circuit breaker/disconnect switch, with a “through-the-door” handle mechanism.
5. Control and safety circuit terminal strip.
6. “Drive-Off-Bypass” selector switch.
7. Pilot lights for “Power On” and “Fault”.
8. “Normal/Test” selector switch, to allow testing and adjustment of the VSD while the motor is running in the bypass mode.

2.3 ENCLOSURES

A. NEMA 1 enclosure for indoor locations. NEMA 3R enclosure for outdoor locations.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Historical Logging Information and Displays:
   1. Real-time clock with current time and date.
   2. Running log of total power versus time.
   3. Total run time.
   4. Fault log, maintaining last four faults with time and date stamp for each.

E. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 HIGH EFFICIENCY DRIVE EQUIPMENT

A. Motors shall conform to the latest applicable requirements of NEMA, IEEE, ANSI, NEC and be U.L. listed. Motors shall be designed for continuous duty. Motors shall feature an engraved, stainless steel nameplate listing horsepower, volts, phase, rated and full load amps, model and serial numbers.

B. All new motors furnished on this project shall be premium efficiency type rated for 240 volt, 3 phase.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 - Execution: Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Report in writing to USPS Project Manager prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

3.2 INSTALLATION

A. Variable Speed Drives:

1. Provide a digital, electronic variable speed drive system that is compatible with the equipment to be controlled and suitable for the application.
2. Provide the services of a factory trained technician to assist in installation, startup and training of Postal Service personnel. Provide filters or other accessories as required to minimize harmonic noise in controlled motors.
3. Connect new VSD's to operate equipment and be controlled by BAS or other method as specified. BAS Controller shall operate all VSD's according to the sequence of operations. VSD control systems requiring operator to make changes at drive unit are not acceptable.
4. Connect VSD to BAS using either twisted pair or shielded cable as required for system furnished. Check that RPM/HERTZ and other readings at BAS are equal to readings at VSD panel. Insure that system is properly grounded and all connections are properly torqued to manufacturer's recommendations.
5. Set minimum speed to allow proper motor cooling and lubrication (normally 20 percent).
6. Mount VSD (normally on wall) to allow for less than 25 feet of lead length between the drive and motor to prevent voltage reflection. Allow for proper air flow around VSD for cooling and service access. Check for over-voltage by measuring the phase-phase voltage at the motor terminals.
7. Provide line reactors with 3 to 5 percent impedance or use filter device between drive and motor where required to compensate for power fluctuations (surges and drops).
8. Mount drive in location to provide adequate ventilation for heat dissipation. Provide dust free enclosures with exterior heat sink where required by environment.
9. Coordinate startup and testing with controls contractor. All controls shall be installed and ready to function in accordance with the sequence of operations prior to final testing and training. Adjust controller to update minimum of twice per second.
10. Where multiple pump or fan systems are designed to operate in parallel, adjust VSD to maintain speeds within 20 revolutions per minute of each other when multiple motors are operating.

B. High Efficiency Motors:
1. Provide premium efficiency drive motors that are compatible with digital electronic variable speed drive systems and suitable for the application.
2. Securely mount and connect new motors to new VSD in accordance with manufacturer's recommendations, the National Electrical Code and as noted above. Size wiring as specified and per the NEC. All wiring shall be run in conduit suitable for the application.
3. For three phase motors, verify direction of rotation. Verify proper grounding. Check phase to phase voltage and phase to ground voltage. Report results to the USPS Project Manager.
4. Torque all connections per manufacturer's recommendations.
5. Provide thermal overloads in starter sized for the application.
6. Check operation of system complies with the sequence of operations.

3.3 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field testing and inspection.

END OF SECTION

SECTION 283100

FIRE DETECTION AND ALARM SYSTEM (HORN/STROBES)

PART 1 - GENERAL

1.1 SUMMARY

A. This specification provides the minimum requirements for the Life Safety System. The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:
   1. Initiating devices.
   2. Inspection and testing.

B. Related Sections:
   1. Section 260500 - Common Work Results for Electrical.

1.2 REFERENCES

A. All work and materials shall conform to all applicable federal, state and local codes and regulations governing the installation. If there is a conflict between the reference standards, federal, state or local codes, and this specification, it is the bidder's responsibility to immediately bring the conflict to the attention of the engineer for resolution. National standards shall prevail unless local codes are more stringent. The equipment and installation shall comply with the current provisions of the following codes and standards.

B. American National Standards Institute (ANSI):
   1. ANSIS3.411, Audible Emergency Evacuation Signals.
   2. ANSI/UL 1971, Standard for Safety Signaling devices for Hearing Impaired.

C. National Fire Protection Association (NFPA):
   1. NFPA 70, National Electrical Code.
   2. NFPA 72, National Fire Alarm Code.
   3. NFPA 101, Life Safety Code.
   4. NFPA 720, Installation of Carbon Monoxide (CO) Detection and Warning Equipment.

D. Underwriters Laboratories, Inc.(UL):
   1. UL864 – Control Units for Fire Protective Signaling Systems.
   2. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
   3. UL 268A - Smoke Detectors for Duct Applications.
   4. UL 217 - Single and Multiple Station Smoke Alarms.
   5. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
   6. UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.
   7. UL 464 - Audible Signaling Appliances.
   8. UL 38 - Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems.
   9. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems.
   10. UL 1971 - Signaling Devices for the Hearing-Impaired.
   11. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
   12. UL 1635 - Digital Alarm Communicator System Units.

E. Federal Codes and Regulations
   1. Americans with Disabilities Act (ADA)

F. International Standards Organization (ISO)
   1. ISO-9000
   2. ISO-9001

G. Factory Mutual (FM)
   1. Provide factory mutual approval.

1.3 Definitions:

A. Authority Having Jurisdiction: See Public Authorities.

B. Engineer of Record: A Professional Engineer Registered in the State where the project is located who undertakes final design of the fire protection system.

C. Owner: Building/facility owner, landlord/lessor, tenant/lessee, Insurance Carrier or any designated representative of these entities.

D. Public Authorities: Local, State or Federal government body having jurisdiction over any portion of the project. This includes, but is not limited to: building departments, Fire Departments, Fire Marshals Offices, Aviation Authorities, Insurance Regulatory Boards, etc.

E. Central Station: A remote supervising station (facility) that is listed for central station remote monitoring in accordance with NFPA 72. The central station serves as the constantly attended location that receives alarm, supervisory or trouble signals from the protected premises fire alarm system.

1.4 SYSTEM DESCRIPTION

A. General
   1. The Contractor shall furnish all labor, services and materials necessary to furnish and install a complete, functional protected premises fire alarm system consisting of horn and strobe (System). The System shall comply in all respects with the requirements of the specifications, manufacturer's recommendations and Underwriters Laboratories Inc. (ULI) listings.
   2. Certification that the entire system has been inspected and tested, is installed entirely in accordance with the applicable codes, standards, manufacturer's recommendations and UL listings, and is in proper working order. Contractor shall use "Fire Alarm System Certification and Description" as required by NFPA 72.

B. 24VDC NACs
   1. Provide and install a new fire detection and alarm system that shall consist of:
      a. Duct smoke detectors.

1.5 Sequence of Operations

A. General 24 VDC NACs
   1. The alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler waterflow, the following functions shall automatically occur:
      a. The internal audible device shall sound at the control panel and remote annunciator.
      b. The LCD display shall indicate all applicable information associated with the alarm condition including; device type, device location and time/date.
      c. All system activity/events shall be documented in system history.
      d. Any remote or local annunciator LCD/LED's associated with the alarm shall be illuminated.
      e. Activate notification audible appliances throughout the building.

f. Activate visual strobes notification appliances throughout the building. The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the "Alarm Silence" is pressed.
g. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
h. All exit doors shall unlock throughout the building.
i. All self-closing fire/smoke doors held open shall be released.

B. Duct Smoke Operation
1. The Alarm activation of any duct smoke detector, the following functions shall automatically occur:
a. The internal audible device shall sound at the control panel and remote annunciator.
b. The LCD display shall indicate all applicable information associated with the alarm condition including; device type, device location and time/date.
c. All system activity/events shall be recorded in the system history file.
d. Any remote or local annunciator LED's associated with the alarm shall be illuminated.
e. Shutdown the local air handling unit.
f. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

1.6 System Configuration

A. General
1. All Life Safety System equipment shall be arranged and programmed to provide a system for the early detection of fire, the notification of building occupants, the automatic summoning of the local fire department when required, the override of the HVAC system operation, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants.
2. The System shall utilize independently addressed, smoke detectors, heat detectors and input/output modules as described elsewhere in this specification.

B. Initiating Device Circuits
1. The Initiating device circuits (IDC) used to monitor manual fire alarm stations, smoke and heat detectors, shall be Class B.

C. 24 VDC Notification Appliance Circuits
1. 24 VDC Notification appliance circuits (NAC) shall be Class B. All notification appliance circuits shall have a minimum circuit output rating of 2 amp @ 24 VDC. The notification circuits shall be power limited. Non-power limited circuits are not acceptable.

1.7 SUBMITTALS

A. As specified in Section 260500 – Common Work Results for Electrical.

B. Section 013300 - Submittal Procedures: Procedures for submittals.
1. Product Data:
a. Provide electrical characteristics and connection requirements.
2. Assurance/Control Submittals:
a. Design Data: System operation description indicating method of operation and supervision of each component and each type of circuit, and sequence of operations for all manually and automatically initiated system inputs for this specific Project. Manufacturer's standard descriptions for generic systems not permitted.
b. Test Reports: Submit the following reports directly to USPS Project Manager from Manufacturer's Quality Control Inspector, with copy to Contractor. Prepare reports in conformance with Section 014000 - Quality Requirements:

1) Pre-test.
2) Acceptance test.

c. Certificates: Manufacturer's certificate certifying that components and Products meet or exceed specified requirements.

d. Qualification Documentation:
1) Submit documentation of manufacturer and installer experience indicating compliance with specified qualification requirements. Include lists of completed projects with project names and addresses, and names of Engineers and Owners.
2) Fire alarm contractor license issued by State or local authority having jurisdiction.

e. Manufacturer's Field Reports: Submit the following reports directly to USPS Project Manager from Manufacturer's Quality Control Inspector, with copy to Contractor. Prepare reports in conformance with Section 014000 - Quality Requirements.
1) Preparatory inspection.
2) Initial inspection.
3) Follow-up inspection.
4) Final inspection.

f. All drawings shall be reviewed and signed off by an individual having a minimum of a NICET certification in fire protection engineering technology, subfield of fire alarm systems.

g. A copy of the installing technician's NICET certification shall be provided.

C. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals:
1. Operation and Maintenance Data: Project specific operating manuals covering the installed Life Safety System. A generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement. Include user's software data and recommendations for spare parts to be stocked at the site. Provide names, addresses, and telephone numbers of service organizations that stock repair parts for the system.
2. Project Record Documents: As-Built drawings consisting of a scaled plan of entire building showing the placement of each individual item of the Life Safety System equipment as well as cable and/or raceway sizes and routings. All drawings must reflect point to point wiring, device address and programmed characteristics. All drawings shall be provided in AutoCAD format. A vellum plot of each sheet shall also be provided. Provide the application program listing for the system as installed at the time of acceptance (disk, hard copy printout, and all required passwords).
3. Record of Completion: Figure 4.5.2.1 NFPA 72.

1.8 QUALITY ASSURANCE

A. As specified in Section 260500 – Common Work Results for Electrical.

B. Manufacturer Qualifications: Firm experienced in manufacturing equipment of the types and capacities indicated that have record of successful in-service performance with minimum 5 years documented experience. Prime system manufacturer and manufacturers of major system components required to qualify separately.
1. Service Center: The System Supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the owner notifying the contractor.

C. Installer Qualifications: Experience with systems of the type and scope indicated and certified as authorized service representative of the prime system manufacturer with minimum 5 years documented experience.
1. System shall be installed by a single contractor that assumes responsibility for system components and their compatibility.
2. Only manufacturer's certified installers with NICET Level III or higher shall be utilized.

D. Regulatory Requirements:
1. Calculations, Product Data, Shop Drawings: Provide stamp of approval from Public Authorities.

2. Comply with requirements of Public Authorities for submittals, approvals, materials, installation, inspections, and testing.
3. Comply with requirements of USPS Project Manager and Owner's insurance underwriter for submittals, approvals, materials, installation, inspections, and testing.
4. Provide certificate of compliance from Public Authorities indicating approval of field acceptance tests.
5. Conform to applicable code for submission of design and calculations, reviewed shop and erection drawings and as required for acquiring permits.
6. Cooperate with regulatory agency or authority and provide data as requested.
7. Provide Smoke detector in room containing Fire Alarm Control Panel per NFPA 72, section 4.4.5.

1.9 MAINTENANCE

A. Section 017704 - Closeout Procedures and Training: Procedures for closeout submittals.

B. Extra Materials: Furnish extra materials described below that match products installed, packaged with protective covering for storage and identified with labels clearly describing contents.
1. Fire Alarm Devices: Furnish quantity equal to 5 percent of the number of units of each type installed but not less than 1 of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All equipment and components shall be the manufacturer’s current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

B. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
1. Siemens, (800) 262-7976.
2. Edwards, (800) 655-4497.
3. Honeywell/Notifier, (800) 289-3473.
4. Simplex/Grinnell, (978)731-2500.

C. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted subject to approval of USPS Project Manager.
1. Conflicts, deviations, or change requests shall be submitted in writing to USPS Project Manager with supporting documentation. Include written justification, designs, manufacturer's specifications, cost benefits, and any special circumstances dictated by local conditions. Documentation package shall be submitted in sufficient time to minimize any adverse effects of the proposed changes to the project construction schedule. USPS Project Manager reserves the right to reject substitute and other systems.

2.2 FIELD-MOUNTED SYSTEM COMPONENTS

A. Smoke Detectors and Accessories
1. Smoke Detector - Photoelectric (Duct Mounted)
a. Provide analog/addressable photoelectric smoke detectors at all duct applications. The system shall have the ability to set the sensitivity and alarm verification of each of the

individual detectors on the circuit. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. Each smoke detector shall be capable of transmitting alarm signals as well as normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80 percent and 100 percent of the allowable environmental compensation value.

b. Provide key operated “normal-reset-test” switch at each duct smoke detector.

c. Basis of Design: Edwards model SIGA-PD.

2. Duct Detector Housing

a. Provide smoke detector duct housing assemblies to mount an analog/addressable detector along with a standard, relay or isolator detector mounting base. The housing shall also protect the measuring chamber from damage and insects. The housing shall utilize an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. Drilling templates and gaskets to facilitate locating and mounting the housing shall also be provided. The housing shall be finished in baked red enamel. Remote alarm LED indicators and remote test stations shall be provided.

b. Basis of Design: Edwards model SIGA-DH.

2.3 CONDUCTORS

A. The requirement of this section apply to all system conductors, including all signaling line, initiating device, notification appliance, auxiliary function, remote signaling, AC and DC power and grounding/shield drain circuits, and any other wiring installed by the Contractor pursuant to the requirements of these Specifications.

B. All circuits shall be rated power limited in accordance with NEC Article 760.

C. Installed in conduit or enclosed raceway.

D. All new system conductors shall be of the type(s) specified herein.

1. All initiating circuit, signaling line circuit, AC power conductors, shield drain conductors and grounding conductors, shall be solid copper, stranded or bunch tinned (bonded) stranded copper.
2. All signaling line circuits, including all addressable initiating device circuits shall be 18 AWG minimum multi-conductor jacketed twisted cable or twisted shielded or as per manufacturer's requirements.
3. All non-addressable initiating device circuits, 24 VDC auxiliary function circuits shall be 18 AWG minimum or per manufacturer's requirements.
4. All notification appliance circuit conductors shall be solid copper or bunch tinned (bonded) stranded copper. Where stranded conductors are utilized, a maximum of 19 strands shall be permitted for #12/AWG and larger conductors. Minimum size conductor shall be #12 AWG.
5. All visual notification appliance circuits shall be #12 AWG minimum THHN or twisted pairs or twisted shielded pairs or per manufacturer's requirements.
6. Color code fire alarm conductors as follows:

ITEM	COLOR
Initiating Device	Orange/Brown

7. All conductors shall be terminated with crimp type, open end, space lugs using tool approved by lug manufacturer. Terminal cabinets shall be provided with screw type terminal strips and plywood backboards.

2.4 CONDUCTORS AND RACEWAY

A. Except as otherwise required by Code and/or these Specifications, the installation of all system circuits shall conform to the requirements of Article 760 and raceway installation to the applicable sections of NFPA 70, National Electrical Code. Fire alarm circuit wiring shall include all circuits described in Section 760.1 including Fine Print Note No. 1 (FPN No. 1), and as defined by the manufacturer's UL listing.

B. The entire system shall be installed in a skillful manner in accordance with approved manufacturer's installation manuals, shop drawings and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type required by the NEC and approved by local authorities having jurisdiction for the purpose.

C. Any shorts, opens, or grounds found on new or existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

D. The contractor shall neatly tie-wrap all field-wiring conductors in the gutter spaces of the control panels and secure the wiring away from all circuit boards and control equipment components. All field-wiring circuits shall be neatly and legibly labeled in the control panel. No wiring except home runs from life safety system circuits and system power supply circuits shall be permitted in the control panel enclosures. No wiring splices shall be permitted in a control panel enclosure.

E. All penetration of floor slabs and firewalls shall be fire stopped in accordance with all local fire codes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. As specified in Section 260500 - Common Work Results for Electrical.

3.2 INSTALLATION

A. General
   1. All equipment shall be attached to walls and ceiling/floor assemblies and shall be mounted firmly in place. Detectors shall not be supported solely by suspended ceilings. Fasteners and supports shall be sized to support the required load.

B. Installation Sequence
   1. Installation of the systems shall be conducted in stages and phased such that circuits and equipment are installed in the following order:
      a. Riser conduits, AC power conduits and control cabinets.
      b. Control panel(s), control component(s), remote annunciator(s), and printer(s).
      c. Conduits and wiring for complete notification circuits and appliance installation throughout facility.
      d. Pre-test the audible and visual notification appliance circuits.
      e. Install all new detection devices.
      f. Terminate between field devices and the associated control equipment.
      g. Complete the interface to all suppression and ancillary shutdown systems.
      h. Complete contractor pre-test of system.
      i. Complete system testing.

C. Install products in accordance with NFPA Standards and manufacturer's published instructions.

D. Install manual station with operating handle 44 inches above floor. Install audible and visual signal devices in accordance with NFPA 72 and ANSI/UL 1971.

E. Mount end-of-line device at the last easily accessible device or within separate box adjacent to the last device.

F. Make wiring connections to equipment devices. Conduct all testing, including HVAC Equipment shutdown, initiated by fire alarm devices.

G. Surge suppression shall be provided for all 120 Volt fire alarm equipment and all low voltage wiring exiting or exterior of the facility.

H. Automatic Detector Installation: Conform to NFPA 72.

3.3 PREPARATION

A. Coordinate work of this Section with other affected work and construction schedule.

3.4 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field testing and inspection.

B. Test in accordance with NFPA 72 and local fire department requirements. Use "Record of Completion" Figure 4.5.2.1 (NFPA 72).

C. Manufacturer's Field Services: Provide services of NICET certified Level III technician to supervise installation, adjustments, final connections, and system testing. Submit written certification on manufacturers letterhead to USPS Project Manager that system has been installed in accordance with applicable codes and is functioning properly. Provide copy of "Certificate of Completion" and place inside plastic envelope at Fire Alarm Control Panel.

D. Inspection:
   1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
   2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Pretesting: Align and adjust system and perform pretesting of components, wiring, and functions to verify conformance with specified requirements. Correct deficiencies by replacing malfunctioning or damaged items with new items. Retest until satisfactory performance and conditions are achieved.

F. Acceptance Operational Tests:
   1. Perform operational system tests to verify conformance with specifications:
      a. Each alarm initiating device installed shall be operationally tested in the presence of a USPS Project Manager’s representative. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified.
      b. Test each Signal Appliance installed for proper operation. Submit written report indicating sound levels at specified distances.
      c. Test Fire Alarm Control Panel
   2. Provide minimum 10 days notice of acceptance test performance schedule to USPS Project Manager, and local fire authorities having jurisdiction.

3. The Contractor shall provide certification that the system is installed entirely in accordance with the system manufacturer's recommendations and within the limitations of the required listings and approvals, that all system hardware and software has been visually inspected and functionally tested by a manufacturer's certified representative, and that the system is in proper working order.

G. Retesting: Correct deficiencies and retest until total system meets the requirements of Specifications and complies with applicable standards.

3.5 WARRANTY AND MAINTENANCE

A. Warranty: The contractor shall warranty all materials, installation and workmanship for 12 months year from date of acceptance, unless otherwise specified. A copy of the manufacturer's warranty shall be provided with close-out documentation and included with the operation and installation manuals.

3.6 TRAINING

A. The System Supplier shall schedule and present a minimum of four (4) hours of documented formalized instruction for the building owner, detailing the proper operation of the installed System.

B. The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

C. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

D. Instruction shall be made available to the Local Municipal Fire Department if requested by the AHJ.

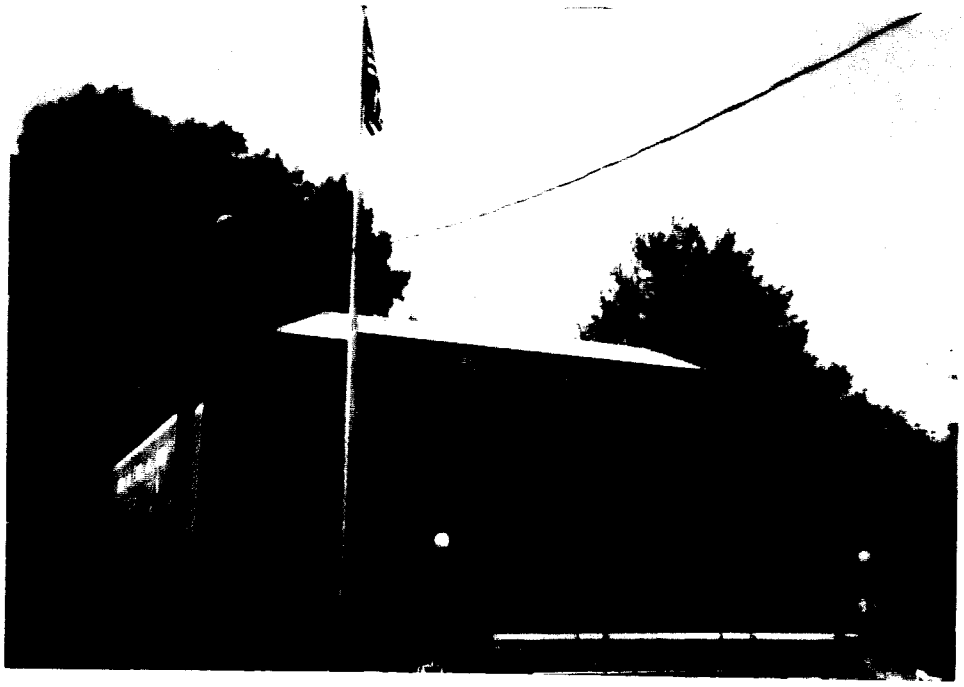
Appendix A

Asbestos-Containing Material Report

ASBESTOS, LEAD HAZARD AND PETROLEUM STORAGE TANK SURVEY

FOR

LEXINGTON MAIN POST OFFICE
LEE AVENUE & NELSON STREET
LEXINGTON, VIRGINIA 24450-9998
FACILITY ID NO. 515148-G01



Prepared for:

UNITED STATES POSTAL SERVICE

Richmond District

Prepared by:

EH&A

Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

11838 Rock Landing Drive, Suite 250
Newport News, Virginia 23606

August 1, 1997

Project No. 18794-16

9716369

Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

August 1, 1997

Mr. Stephen E. Chippendale
Environmental Compliance Coordinator
United States Postal Service
Richmond District
Perrin Building
1801 Brook Road
Richmond, Virginia 23232-9991

Re: Asbestos, Lead Hazard and Petroleum Storage Tank Survey Report for Lexington Main Post Office, Lexington, Virginia
Contract No. 362575-94-J-0153
Work Order No. 413.00

Dear Mr. Chippendale:

Espey, Huston and Associates, Inc. (EH&A) is pleased to submit two copies of the above referenced report, in completion of our Work Order 413.00.

Based on the scope of our study, asbestos was detected in samples of friable and non-friable materials. The following report of findings details the results of the sampling and recommended response actions for the asbestos-containing building materials identified at the Lexington Main Post Office facility. The results of the asbestos survey also have been entered into the U.S. Postal Service Environmental Management Information System (EMIS) Survey Module, which is submitted under separate cover.

The following report details the results of the lead hazard investigation and includes recommended response actions. The lead in drinking water samples collected at this facility meet the EPA lead in drinking water standard.

No aboveground or underground petroleum storage tanks were identified at this facility.

We appreciate this opportunity to provide our environmental services on this project. Please feel free to call me at (757) 596-8267 if you have any questions.

Sincerely,

Dennis Papa, P.G.
Project Manager

cc: Larry Cramer, Postmaster, Lexington Main Post Office
File 18794 3.3.2, 3.9.1

Project No. 18794-16

9716369

11838 Rock Landing Drive, Suite 250 ■ Newport News, Virginia 23606-4232
(757) 596-8267 TEL ■ (757) 596-8660 FAX

TABLE 1
Summary of Findings

Lexington Main Post Office
June 24, 1997

Description	Result	Location	Amount of Material	Photo #	Recommendation	Abatement Cost	Comments
Asbestos-containing building materials:							
9"x9" green floor tile	10% Chrysotile	Storage Conference room Inspector's office Restroom	400 ft^2 320 ft^2 220 ft^2 42 ft^2	1	Take steps to reduce the potential for disturbance. Manage material under an O&M Plan covering the proper care and handling of asbestos-containing floor tile mastic.	Removal: $4,439 Replacement: $2,946 Project Monitoring: $1,787	
Insulation on 2" line	25% Chrysotile	Attic	30 lf	3	Take steps to reduce the potential for disturbance. Manage material under an O&M plan.	Removal: $972 Replacement: $667 Project Monitoring: $667	

Lexington Main Post Office
June 24, 1997

Description	Result	Location	Amount of Material	Photo #	Recommendation	Abatement Cost	Comments
Lead Hazards:							
Beige paint on wall	0.06% lead by weight	Main work area	~5000 ft^2 on 10 walls	8	Follow OSHA lead standards during renovations	N/A	
Brown paint on bumper guard	0.14% lead by weight	Main work area	12 lf on 4 bumpers	9	Follow OSHA lead standards during renovations	N/A	
Grey paint on wall	0.13% lead by weight	Mechanical room	~2,000 ft^2 on 8 walls	10	Follow OSHA lead standards during renovations	N/A	
Green paint on door	0.21% lead by weight	Mechanical room	72 ft^2 on 4 doors	NA	Follow OSHA lead standards during renovations	N/A	
Grey paint on door	0.50% lead by weight	Hallway in basement	180 ft^2 on 10 doors	11	Follow OSHA lead standards during renovations	N/A	
White paint on window	22% lead by weight	Exterior of building	~ 400 lf on 20 windows	12	Follow OSHA lead standards during renovations	N/A	
Brown paint on column	29% lead by weight	Loading dock	40 lf on 4 columns	13	Follow OSHA lead standards during renovations	N/A	
Yellow paint on lift	0.11% lead by weight	Loading dock	16 ft^2 on 1 lift	NA	Follow OSHA lead standards during renovations	N/A	
Lead in Drinking Water:							
None detected above the EPA Standard							

Lexington Main Post Office
June 24, 1997

Description	Result	Location	Amount of Material	Photo #	Recommendation	Abatement Cost	Comments
Petroleum Storage Tank:	**Status**	**Location**	**Tank Size**	**Photo #**	**Recommendation**	**Abatement Cost**	**Comments**
None identified at this facility							

1.0 EXECUTIVE SUMMARY

Postal Facility: Lexington Main Post Office
Nelson Street
Lexington, Virginia 24450-9998
Contract No.: 362575-94-J-0153
Work Order No.: 413.00

Espey, Huston & Associates, Inc. (EH&A) conducted an asbestos-specific building survey for the presence of asbestos-containing building materials (ACBM) at the above referenced facility. A lead hazard investigation, lead in drinking water sampling and petroleum storage tank survey was conducted concurrently with the asbestos survey. This inspection took place on June 24, 1997.

1.1 Description of the Facility

The inspector conducted a preliminary "walk through" of the facility. No hazardous material abatement surveys or abatement reports were available with respect to past renovation activities. Additionally, the inspector requested to review any and all building blueprints, construction drawings, and/or previous environmental surveys. Building blueprints and construction drawings were unavailable at this time.

The Lexington Main Post Office is a stand-alone building constructed of brick and block. The facility has a basement built on a concrete slab. The roof consists of a metal dome with a flat, built-up surface. The facility was constructed in approximately 1913. The building is heated with natural gas and cooled by an electric air conditioning system.

1.2 Summary of Findings and Recommendations

1.2.1 Asbestos-containing building materials

The inspection included the collection of 27 samples of both friable and non-friable suspect asbestos-containing building materials to be analyzed for asbestos content. The results of the sampling identified the following:

Asbestos-Containing Surfacing Materials

- The samples of suspect asbestos-containing surfacing materials identified at this facility indicated that no asbestos was present.

Asbestos-Containing Thermal System Insulation

- The insulation on the 2" line in the attic

Asbestos-Containing Miscellaneous Materials

- The 9"x9" green floor tile in the storage room, conference room, Inspector's office, and restroom.

The insulation on the 2" line in the attic was in good condition at the time of the survey. The material has a low potential for damage because it is located in an isolated area in the attic. This material should be managed under the Operations and Maintenance (O&M) plan provided in Appendix H of this report.

4.0 FINDINGS AND RECOMMENDATIONS

On June 24, 1997, Carter Ficklen III of EH&A performed an asbestos-specific building inspection, lead-hazard investigation, lead in drinking water survey and petroleum storage tank survey at the Lexington Main Post Office located at Nelson Street in Lexington, Virginia, on behalf of the United States Postal Service.

4.1 Asbestos-Containing Building Materials (ACBM)

The asbestos inspection called for the identification and sampling of suspect asbestos-containing building materials (ACBM) by Homogeneous Sampling Areas. A Homogeneous Sampling Area contains material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type, or formulation, of material. The inspector collected 27 bulk samples from the various Homogeneous Sampling Areas listed in Table 2. The asbestos-containing building materials identified at this facility are described in Section 4.1.1 and Section 4.1.2, following Table 2. Table 2 additionally summarizes the sampling results for the asbestos samples collected at this facility. The sample ID and Sample Result for each sample of Homogeneous Sampling Area is listed adjacent to the room location in which the sample was collected.

TABLE 2
Asbestos Sampling Results for Lexington Main Post Office
June 24, 1997

Hom. Area #	Friable or Non-friable (F/NF)	Material Description	Amount of Material	Location	Sample ID	Sample Result
01	NF	12"x12" Beige floor tile	288 ft^2	Main work area	413-AB-01-01T 413-AB-01-02T 413-AB-01-03T	0% Asbestos 0% Asbestos 0% Asbestos

Hom. Area #	Friable or Non-friable (F/NF)	Material Description	Amount of Material	Location	Sample ID	Sample Result
02	NF	Beige mastic under the 12"x12" beige floor tile	288 ft²	Main work area	413-AB-01-01M 413-AB-01-02M 413-AB-01-03M	0% Asbestos 0% Asbestos 0% Asbestos
03	**NF**	**9"x9" green floor tile**	**400 ft²** **320 ft²** **220 ft²**	**Storage room** **Conference room** **Inspector's office** **Restroom**	**413-AB-13-04T** **413-AB-14-05T** **413-AB-16-06T**	**10% Chrysotile** **10% Chrysotile** **10% Chrysotile**
04	NF	Black mastic under the 9"x9" green floor tile	400 ft² 320 ft² 220 ft²	Storage room Conference room Inspector's office Restroom	413-AB-13-04M 413-AB-14-05M 413-AB-16-06M	0% Asbestos 0% Asbestos 0% Asbestos
05	F	2'x4' white ceiling tile	320 ft² 220 ft²	Conference room Inspector's office	413-AB-13-07	0% Asbestos
06	NF	Plaster material on walls and ceiling	5,600 ft² 2,800 ft² 800 ft² 200 ft² 400 ft² 1,400 ft² 420 ft² 720 ft² 800 ft² 720 ft² 600 ft² 1,200 ft² 400 ft²	Main work area Lobby Storage room Employee entrance Mailing vestibule Inspector's lookout Postmaster's office Swing room Storage room Conference room Inspector's office Mechanical room Hallway in basement	413-AB-01-08 413-AB-01-09 413-AB-11-10 413-AB-12-11 413-AB-14-12 413-AB-19-13 413-AB-19-14	0% Asbestos 0% Asbestos 0% Asbestos 0% Asbestos 0% Asbestos 0% Asbestos 0% Asbestos
07	**F**	**Insulation on 2" line**	**30 lf**	**Attic**	**413-AB-22-15** **413-AB-22-16** **413-AB-22-17**	**25% Chrysotile** **Not analyzed** **Not analyzed**
08	F	Insulation on 4" line	25 lf	Attic	413-AB-22-18 413-AB-22-19 413-AB-22-20	0% Asbestos 0% Asbestos 0% Asbestos
09	F	Fill insulation in attic	500 ft2	Attic	413-AB-22-21	0% Asbestos
10	NF	12"x12" white floor tile	164 ft² 180 ft²	Storage room Hallway in basement	413-AB-21-22T 413-AB-21-23T 413-AB-21-24T	0% Asbestos 0% Asbestos 0% Asbestos
11	NF	Black mastic under the 12"x12" white floor tile	164 ft² 180 ft²	Storage room Hallway in basement	413-AB-21-22M 413-AB-21-23M 413-AB-21-24M	0% Asbestos <1% Asbestos <1% Asbestos

Hom. Area #	Friable or Non-friable (F/NF)	Material Description	Amount of Material	Location	Sample ID	Sample Result
12	NF	12"x12" grey floor tile	476 ft^2	Box lobby (Basement)	413-AB-17-25T 413-AB-17-26T 413-AB-17-27T	0% Asbestos 0% Asbestos 0% Asbestos
13	NF	Beige mastic under 12"x12" grey floor tile	476 ft^2	Box lobby (Basement)	413-AB-17-25M 413-AB-17-26M 413-AB-17-27M	0% Asbestos 0% Asbestos 0% Asbestos

0% Asbestos = indicates no asbestos detected in the sample. Method limit of detection is 1%.

4.1.1 Friable ACBM

The sample of pipe insulation collected from the 2" line in the attic (Sample 413-AB-22-15) contained 25% Chrysotile asbestos. Table 2 summarizes the laboratory results for the samples collected at this site. Copies of laboratory analytical data sheets are attached in Appendix C.

4.1.2 Non Friable ACBM

The sample of 9"x9" green floor tile collected from the conference room (Sample 413-AB-13-04T) contained 10% Chrysotile asbestos. Two samples of the black mastic under the 12" x12" white floor tile in the storage room and hallway in the basement (Samples 413-AB-21-23M and 413-AB-21-24M) contained <1% Chrysotile asbestos. The third sample of this material (413-AB-21-22M) contained 0% asbestos. OSHA and EPA define asbestos-containing materials as materials that contain >1% asbestos. Based on the results of the samples collected during this survey, the mastic underneath the 12"x12" white floor tile is not an asbestos-containing building material. Table 2 summarizes the laboratory results for the samples collected at this site. Copies of laboratory analytical data sheets are attached in Appendix C.

4.1.3 Assumed ACBM

The roofing system was inaccessible to the inspector and, therefore, assumed to be inaccessible to the postal staff. For this reason the entire roofing system is assumed to contain asbestos. The roofing system includes the roof decking, roof flashing and any roof mastics. These materials should be sampled and analyzed for asbestos content prior to any future renovation of the roof. Table 3 summarizes the assumed ACBMs located at this site.

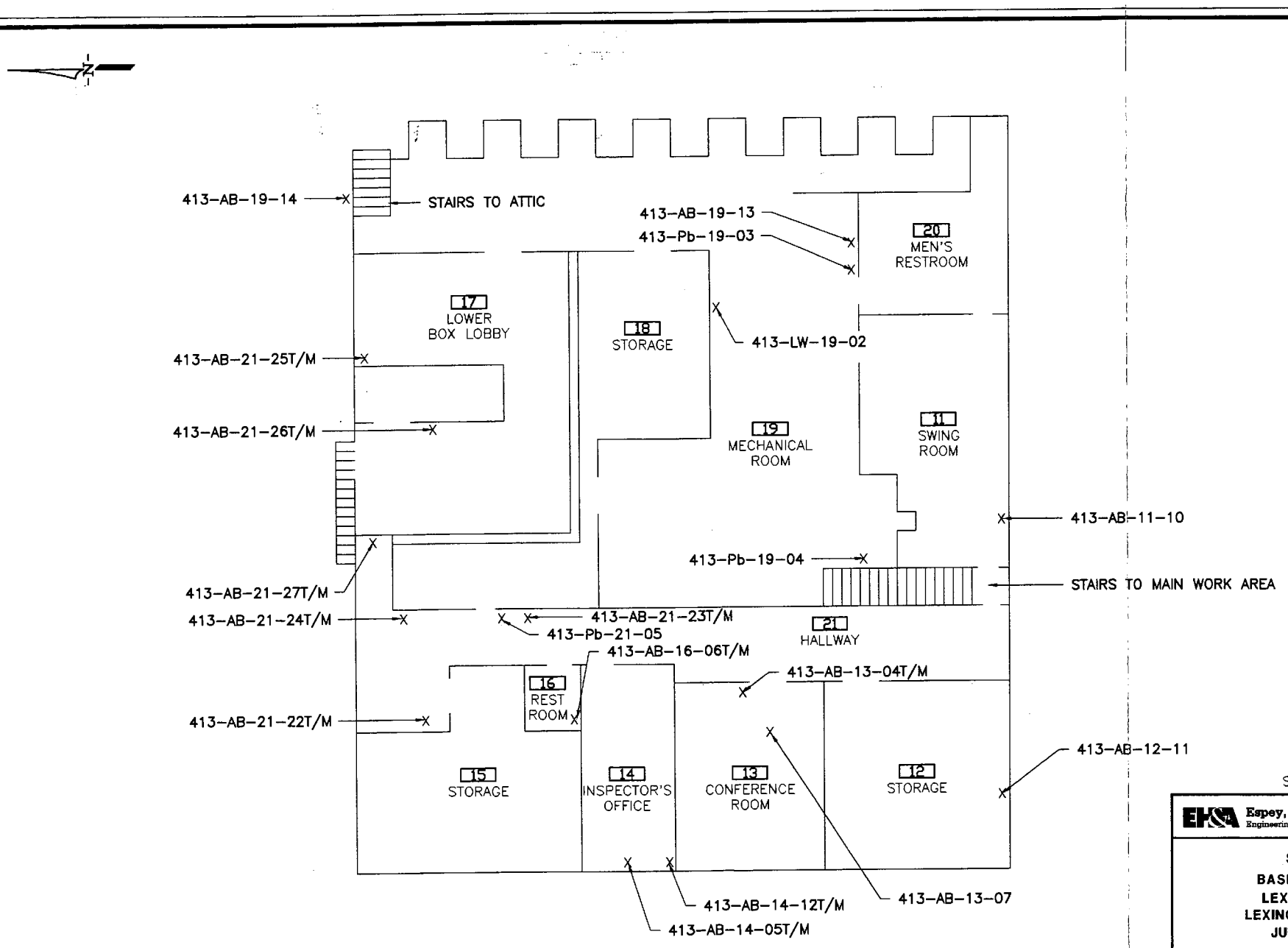
TABLE 3
Assumed Asbestos Containing Material
from Lexington Main Post Office
June 24, 1997

Homogenous Area #	Type of Material	Friable or Non-Friable (F/NF)	Condition	Description
14	Roofing materials	NF	Unknown - inaccessible to the inspector	Roof mastics, flashing, and decking

4.1.4 Recommendations

Based on the sampling results, asbestos was detected in samples of friable and non-friable materials at this facility. In addition to Table 2, information on the individual samples is present in the field sampling logs in Appendix B.

The insulation on the 2" line in the attic was in good condition at the time of the survey. The material has a low potential for damage because it is located in an isolated area in the attic. This material should be managed under the Operations and Maintenance (O&M) plan provided in Appendix H of this report.

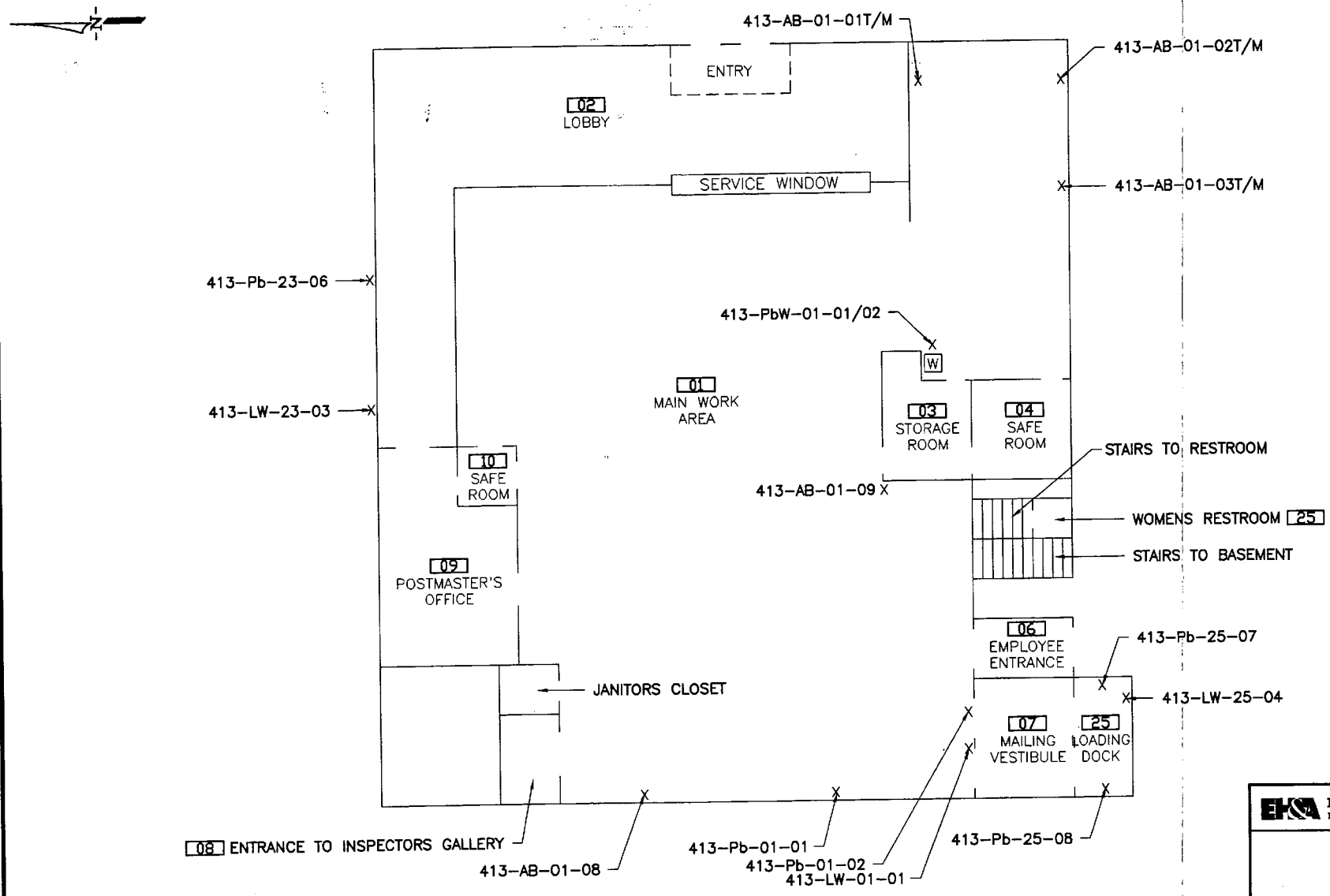


SCALE: 1" = 10'

Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

SITE #413
BASEMENT LEVEL
LEXINGTON MPO
LEXINGTON, VIRGINIA
JUNE 21, 1997

18794-16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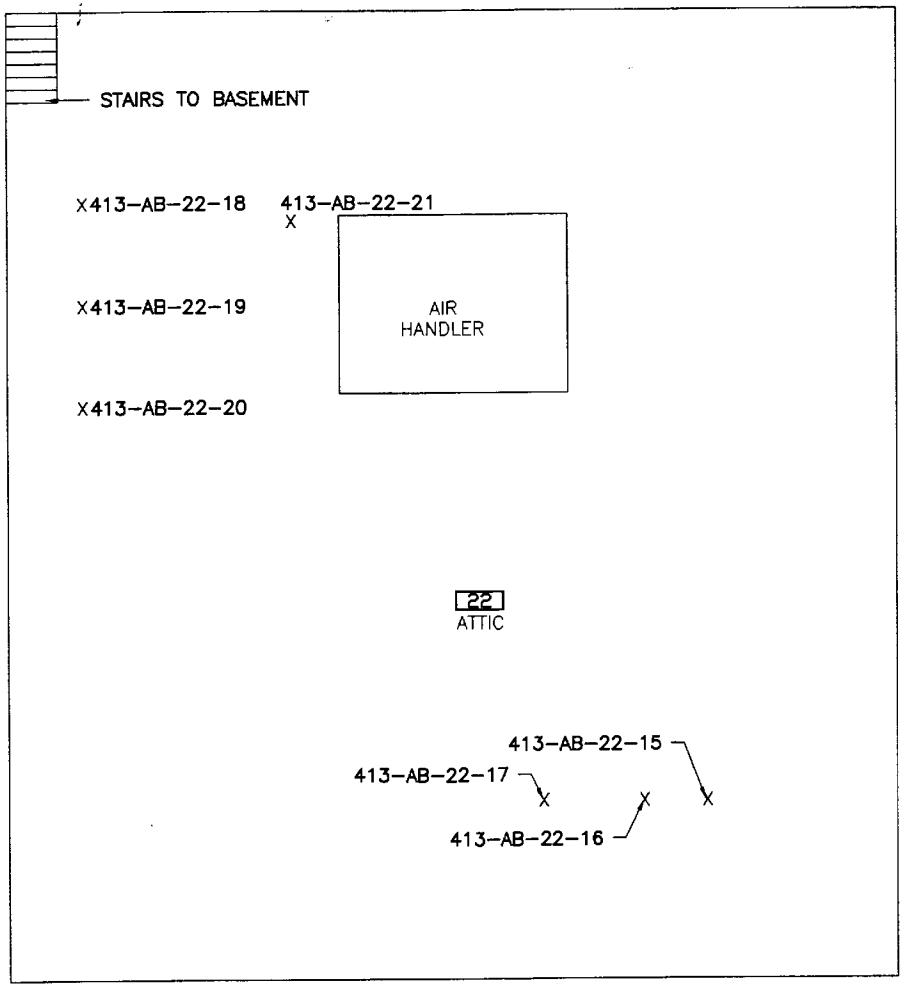
413-AB-01-02T/M
ENTRY
02
LOBBY
SERVICE WINDOW
413-AB-01-03T/M
413-Pb-23-06
413-PbW-01-01/02
W
01
MAIN WORK AREA
413-LW-23-03
03
STORAGE ROOM
04
SAFE ROOM
STAIRS TO RESTROOM
10
SAFE ROOM
413-AB-01-09
WOMENS RESTROOM 25
STAIRS TO BASEMENT
09
POSTMASTER'S OFFICE
06
EMPLOYEE ENTRANCE
413-Pb-25-07
JANITORS CLOSET
413-LW-25-04
07
MAILING VESTIBULE
25
LOADING DOCK
08 ENTRANCE TO INSPECTORS GALLERY
413-AB-01-08
413-Pb-01-01
413-Pb-01-02
413-LW-01-01
413-Pb-25-08
SCALE:1" = 10'
Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants
SITE #413
MAIN LEVEL
LEXINGTON MPO
LEXINGTON, VIRGINIA
JUNE 21, 1997

18794-16



SCALE: 1" = 10'

Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

SITE #413
ATTIC LEVEL
LEXINGTON MPO
LEXINGTON, VIRGINIA
JUNE 21, 1997

18794-16

ESPEY, HUSTON & ASSOCIATES, INC.
Engineering and Environmental Consultants

OPERATIONS AND MAINTENANCE PLAN FOR ASBESTOS-CONTAINING MATERIALS AT LEXINGTON MAIN POST OFFICE LEXINGTON, VIRGINIA

Prepared For:
United States Postal Service
Richmond District
August 1, 1997

Prepared By:
Espey, Huston & Associates, Inc.
11838 Rock Landing Drive, Suite 250
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(757) 596-8267

Prepared By:

Carter Ficklen III
Industrial Hygienist
EPA Accredited Management Planner

Reviewed By:

Dennis Papa, P.G.
Project Manager

Project No. 18794-16

9716369

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1.0 INTRODUCTION

1.1 General

As part of the United States Postal Service's (USPS) continuing commitment to protect the health and safety of our employees at our facilities, this Asbestos Operations and Maintenance (O&M) Plan is designed to provide guidance on how to properly manage asbestos within your facility. The objectives of this Plan are designed to accomplish the following:

A. Identify and locate asbestos containing building materials (ACBMs) in the building and to assess the health hazard potential posed to outside contractors and USPS staff.

B. Through training, education, and identification of ACBMs, minimize the potential for exposure of outside contractors and USPS staff to airborne asbestos fibers.

C. Prevent the uncontrolled disturbance of ACBMs by your staff and by outside contractors.

D. Provide recommendations and guidance for asbestos abatement alternatives, and to document USPS's decisions with respect to those alternatives.

E. Allow trained maintenance staff to safely perform routine maintenance tasks in the areas containing ACBM.

F. Develop a record-keeping system and other procedures necessary to track status and general condition of ACBMs in the building.

G. Designate a person responsible for implementation of the O&M Plan. This person will be identified in this plan as the Asbestos Program Manager (APM).

It is important that all users of this O&M plan have a clear understanding of the purpose and proper use of this plan. If any users (i.e., USPS staff, outside contractors) have a question regarding any of the elements of this plan, or any questions regarding issues involving asbestos, then all questions should be directed to the USPS's Asbestos Program Manager for this facility.

2.0 . . . RESPONSIBILITIES AND ROLE DEFINITIONS

The success of this O&M Plan depends on the active participation and interaction of the management and staff, maintenance personnel, and outside contractors/vendors. Each must clearly understand their role in the O&M Plan. Participation and role definition are as follows:

A. **Asbestos Program Manager** - Provides the overall coordination for implementation of the O&M Plan, and is responsible for all activities related to managing ACBMs within this plan. The duties of the Asbestos Program Manager include the following:

1. Assures that all maintenance personnel are aware of the location of identified ACBMs and are educated in the potential hazards of asbestos.
2. Assures that all outside contractors and vendors are aware that the USPS has an O&M plan which they are to review prior to conducting any work at any of the USPS's properties; And that all contractors and their personnel have signed a release form acknowledging that they have been informed of the presence of ACBMs at the facility.
3. Is responsible for coordination of any asbestos inspections at the facility, biannual inspections of the condition of ACBMs, and pre- and post- job inspections associated with any outside contractor's work at the building.
4. Is responsible for overall management and coordination of any asbestos abatement projects.

B. **Respiratory Protection Program Manager** - Note: Since many maintenance/repair activities described within this O&M plan will involve the use of a respirator, coordination with the USPS's Respiratory Protection Program Manager will be required. This individual will coordinate appropriate respiratory protection for USPS staff involved in asbestos activities and also assure adherence to the USPS's Respiratory Protection Program.

C. **Asbestos Competent Person** - USPS personnel that have obtained either an EPA comprehensive training course for asbestos abatement supervisors as described for Class I and Class II asbestos work or an EPA 16-hour Operations and Maintenance training course for Class III and Class IV asbestos work. The role of the competent person is to perform all responsibilities defined in 29 CFR 1926.1101 Section (o) and to assess whether a maintenance activity involves "contact" (Class IV) or "disturbance" (Class III) of asbestos-containing material. The Competent person should attempt to plan the activity so that it meets the Class IV asbestos work definition so as to minimize the employees exposure to asbestos. These work classes are defined in Section 5.3.1.1 of this O&M plan.

D. **Maintenance Staff** - USPS personnel that are trained in the recognition of ACBMs, potential health hazards associated with airborne exposure to ACBMs, and are trained to use appropriate techniques and procedures to work around ACBMs. They will be responsible for notifying the Asbestos Program Manager if asbestos-containing building materials are damaged or observed to have been disturbed.

E. **Asbestos Abatement Contractor** - A licensed professional contractor who performs asbestos abatement activities, including asbestos removal and encapsulation, in areas deemed necessary by the Asbestos Program Manager. All large scale asbestos abatement activities will be performed by this contractor.

3.0 APPLICABLE REGULATIONS AND GUIDANCE DOCUMENTS

3.1 29 CFR 1926.1101, OSHA's Asbestos Construction Standard

The Occupational Safety and Health Administration's (OSHA) asbestos construction standard regulates the exposure to asbestos during the demolition or salvage of structures where asbestos is present; the removal or encapsulation of materials containing asbestos; the construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos; the installation of products containing asbestos; asbestos spill/emergency cleanup; and the transportation, disposal, storage, containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed.

3.1.1 OSHA Asbestos Work Classes

The OSHA asbestos construction standard includes four classes of asbestos work. Classes I and II involve the removal of asbestos-containing materials and should not directly affect postal employees.

3.1.1.1 Class I Asbestos Related Work

Class I asbestos work includes the activities involving the removal of thermal system insulation (TSI) and surfacing asbestos-containing materials (ACM and presumed asbestos-containing materials (PACM). This class of work should be performed by EPA trained asbestos abatement contractors and not postal employees.

3.1.1.2 Class II Asbestos Related Work

Class II asbestos work includes activities involving the removal of ACM which is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics. Class II asbestos work should be performed by EPA trained asbestos abatement contractors and not postal employees.

3.1.1.3 Class III Asbestos Related Work

Class III asbestos work includes the repair and maintenance operations, where ACM, including TSI and surfacing material, is likely to be disturbed. "Disturbance" means activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. These types of operations may include drilling, abrading, cutting a hole, cable pulling, crawling through tunnels, or attics and spaces above ceilings where asbestos is actively disturbed or asbestos-containing debris is actively disturbed. **The only Class III tasks sanctioned by postal policy are limited lifting of asbestos-containing flooring and drilling through asbestos-containing flooring.**

3.1.1.4 Class IV Asbestos Related Work

Class IV asbestos work includes maintenance and custodial activities during which employees contact ACM and PACM and activities to clean up waste and debris containing ACM and PACM. Under Class IV work, employees may contact ACM, but do not disturb ACM. In addition, employees may clean up dust, waste, and debris resulting from Class I, II or III asbestos work activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists, and cleaning up loose ACM debris from TSI or surfacing ACM/PACM following a construction activity. **In some situations, postal employees will engage in limited Class IV work, e.g. cleaning in areas with ACM.**

3.2 29 CFR 1926.1001, OSHA's Asbestos General Industry Standard

OSHA's asbestos general industry standard applies to all occupational exposures to asbestos in all industries covered by the Occupational Safety and Health Act, except those exposures that are covered by the OSHA asbestos construction standard and the exposures that are a result of ship repairing, shipbuilding and shipbreaking. This standard does cover exposures to asbestos during custodial activities and automotive clutch and brake service - activities which postal employees may perform.

3.3 40 CFR Part 763, EPA's Asbestos Hazard Emergency Response Act

The EPA's Asbestos Hazard Emergency Response Act (AHERA) regulation was initially designed to govern asbestos-related activities such as inspecting for asbestos, developing response actions to asbestos, managing asbestos materials, and training of personnel in schools. This regulation is used by the USPS as a guideline to base some of the O&M training requirements which are discussed later in this plan.

3.4 National Institute of Building Science's (NIBS) O&M Guidance Manual

The NIBS guidance manual is a resource used by the USPS and this O&M plan to aid the users of this plan in dealing with maintenance activities that involve asbestos-containing materials. The manual provides a list of various maintenance activities involving asbestos-containing materials, such as removing an asbestos-containing ceiling tile, and details the procedures to perform the maintenance activity under three different work practice categories. The three categories are defined by three separate Work Class Levels. **No postal employees may perform tasks requiring work practices in the Level 3 category**. No tasks defined as OSHA Class I or Class II asbestos work shall be performed by postal employees and limited tasks defined as OSHA Class III asbestos work may be performed by postal employees at the approval and direction of the Competent person or Asbestos Program Manager.

3.4.1 - - - Work Practice Levels

3.4.1.1 Work Practice Level 1

Level 1 Work practice is usually intended to avoid a disturbance of ACBM and release of asbestos fibers, but if ACBMs are disturbed, it is likely that worker and building occupant exposures will be minimal. Tasks performed under this work practice level will meet the criteria for OSHA Class IV asbestos work, and may be performed by postal employees.

3.4.1.2 Work Practice Level 2

Level 2 Work practice is likely to, or intended to , disturb small amounts of ACBM for short periods of time. Worker protection and localized engineering controls are justified, but the disturbance is unlikely to create building occupant exposure or impact to building environment. Postal employees may only engage in limited maintenance tasks under this work practice level with permission from the Competent person or the Asbestos Program Manager, since tasks under this work practice level fall into the definition of OSHA Class III asbestos work. An example of Level 2 Work Practice Level tasks includes "Work Practice M3, Level 2, penetrating resilient asbestos flooring and sub-flooring." Limited hole drilling in resilient flooring may be accomplished by postal employees. Employees performing this type of work practice must have a minimum of 16 hours Asbestos Operations and Maintenance training.

In addition, postal employees may only perform asbestos related work that is defined by the EPA regulations as "Small-Scale, Short Duration Activities" summarized in Section 8.2, of this O&M Plan.

3.4.1.3 Work Practice Level 3

Level 3 Work practice is intended to disturb small amounts of ACBM in ways sufficient to justify engineering controls, and protection of workers, building occupants and the building environment. **This level of work is only to be performed by EPA trained and experienced asbestos abatement contractors.**

4.0 EMPLOYEE TRAINING AND EDUCATION

4.1 2-Hour Asbestos Awareness Training

4.1.1 Training Requirements

Employees requiring this training shall receive training which is consistent with EPA requirements for training local education agency maintenance and custodial staff as set forth in 40 CFR 763 (a)(1). The training shall be at least two hours in length and shall include the following:

1. Information asbestos and its various uses and forms.

2. Information on the health effects associated with asbestos exposure.

3. The locations of asbestos-containing building materials identified throughout each of the buildings in which they work.

4. Recognition of damage, deterioration, and delamination of asbestos-containing building materials.

An annual refresher of this training is required.

4.1.2 Applicable Personnel

The 2-hour Asbestos Awareness training is required for all postal employees who will engage in OSHA Class IV asbestos work. This includes custodians or maintenance personnel working in areas where construction has been accomplished, or where the potential for actually contacting, but not disturbing, ACM or PACM is present. For example, if a maintenance technician must cross ACM pipe lagging to service a piece of equipment, he or she would require the two hour training.

4.2 4-Hour OSHA Hands-on Training

The 4-hour OSHA hand-on training is required for employees who will perform OSHA Class III asbestos work for which the Competent person determines that the EPA curriculum does not cover activities that workers perform. For example, postal employees conducting limited drilling and floor tile lifting. The training shall include the following:

1. Methods of recognizing asbestos, including the requirement in 29 CFR 1926.1101 (k)(1) to presume that certain building materials contain asbestos.

2. The health effects associated with asbestos exposure.

3. The relationship between smoking and asbestos in producing lung cancer.

4. The nature of operations that could result in exposure to asbestos, the importance of necessary protective controls to minimize exposure including, as applicable, engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, and waste disposal procedures, and any necessary instruction in the use of these controls and procedures; where Class III and IV work will be or is performed, the contents of EPA 20T-2003, "Managing Asbestos In-Place" July 1990 or its equivalent in content.

5. The purpose, proper use, fitting instructions, and limitations of respirators as required by 29 CFR 1910.134.

6. The appropriate work practices for performing the asbestos job.

7. Medical surveillance program requirements.

8. The content, including appendices, of 29 CFR 1926.1101.

9. The names, addresses and phone numbers of public health organizations which provide information, materials and/or conduct programs concerning smoking cessation. The employer may distribute the list of such organizations contained in Appendix J of 29 CFR 1926.1101, to comply with this requirement.

10. The requirements for posting signs and affixing labels and the meaning of the required legends for such signs and labels.

In addition to the above mentioned requirements, the training shall include "hands-on" training, and information on the specific work practices and engineering controls defined in 29 CFR 1926.1101 (g).

4.3 16-Hour Operations and Maintenance (O&M) Training

4.3.1 Training Requirements

Employees requiring this training shall receive training which is consistent with EPA requirements for training local education agency maintenance and custodial staff as set forth in 40 CFR 763 (a)(2). The training shall be at least sixteen hours in length and shall include the following:

1. Information asbestos and its various uses and forms.

2. Information on the health effects associated with asbestos exposure.

3. The locations of asbestos-containing building materials identified throughout each of the buildings in which they work.

4. Recognition of damage, deterioration, and delamination of asbestos-containing building materials.

5. Descriptions of the proper methods of handling ACBM.

6. Information on the use of respiratory protection as contained in the EPA/NIOSH *Guide to Respiratory Protection for the Asbestos Abatement Industry*, September 1986 (EPA 560/OPTS-86-001), and other personal protection measures.

7. The provisions of 40 CFR 763.92, 40 CFR 763.92, Appendices A, B, C, D of 40 CFR 763 Subpart E, EPA regulations contained in 40 CFR 763, Subpart G, and in 40 CFR Part 61, Subpart M, and OSHA regulations contained in 29 CFR 1926.1101.

8. Hands-on training in the use of respiratory protection, other personal protective measures, and good work practices.

An annual refresher of this training is required.

4.3.2 Applicable Personnel

The 16-hour O&M training is required for all postal employees who will engage in OSHA Class III asbestos work. This includes maintenance or custodial personnel who will disturb ACM or PACM as a result of the maintenance task.

4.4 "Competent Person" Training

Employees who will perform the duties of a Competent person supervising and/or performing OSHA Class III and IV asbestos work, at a minimum, shall receive the 16-hour O&M training. Competent persons for Class III and IV work may also be trained in a comprehensive course for asbestos abatement supervisors conducted by EPA or state-approved training provider.

4.5 40-Hour Asbestos Inspector/Management Planner Training

It is the responsibility of the Asbestos Program Manager to plan and schedule any asbestos related activities at the building including abatement, emergency response actions, periodic surveillance, maintenance of the management plan, and training of maintenance and custodial staff. In order to fulfill this role properly, the Asbestos Program Manager must have a higher level of asbestos related training. Asbestos Program Managers should receive 40 hours of asbestos inspector/management planner training, as outlined in 40 CFR 763 Subpart E, which will instruct him/her in the details of the inspection process, management plans and operations and maintenance activities. This training may be obtained by EPA or state-approved individual training providers.

5.0 . . . RESPIRATORY PROTECTION PROGRAM

A formal respiratory protection program must be implemented in accordance with 29 CFR 1910.134, (as amended), prior to issuance of respirators to USPS employees. OSHA regulations require a respirator program whenever workers are required to wear respirators or whenever workers are likely to be exposed to asbestos fiber levels above the OSHA Permissible Exposure Level (PEL) of 0.1 fibers/cc or greater. Although maintenance workers will receive some training in respirator care and use as part of the 16-hour O&M training course, a local respirator program under the auspices of the U.S. Postal Service must be established for workers required to wear respiratory protection.

6.0 OSHA REQUIREMENTS FOR MEDICAL SURVEILLANCE

6.1 Medical Surveillance Under OSHA's Asbestos Construction Standard

Medical surveillance must be provided for employees who, for more than 30 days a year, engage in Class I, II, or III, work, employees exposed above the Permissible Exposure Limit (PEL) of 0.1 fibers/cc (8-hour Time Weighted Average), or who wear negative pressure respirators when working with ACM or PACM. **Postal employees, by policy only engage in limited Class III work - lifting and drilling of asbestos flooring. These employees must receive medical surveillance**. Some employees may perform Class IV custodial tasks consisting of cleaning (HEPA vacuuming) areas, e.g. mechanical rooms, containing ACM or PACM. They would only require medical surveillance if the PEL was exceeded.

6.2 Medical Surveillance Under OSHA's Asbestos General Industry Standard

The OSHA General Industry Standard applies to employees working routinely with asbestos that is not construction related, principally brake work in vehicle maintenance facilities. **Any employee exposed to asbestos fibers at or above the PEL must receive medical surveillance as long as that job is performed and asbestos is present**. Given the reduction in the use of asbestos in break lining, and that adequacy of postal control measures e.g. vacuums, few if any VMF postal employees have been affected by this requirement.

Housekeeping work, e.g. polishing vinyl asbestos floor tile, is covered under 29 CFR 1910.1001, but there is adequate data to show that such activities (done properly) do not release asbestos or exceed the PEL, and so medical surveillance is **not required.**

7.0 NOTIFYING BUILDING OCCUPANTS OF ASBESTOS-CONTAINING MATERIALS

Written notifications and labeling are required by AHERA and also satisfy affected persons' "right to know" about hazards that may affect their health and welfare. This hazard communication is a first step in educating individuals that their personal actions affect ACBMs within their work area. The following subsections discuss this AHERA requirement.

7.1 Labeling and Placarding of ACBM

Warning labels will be placed immediately adjacent to all friable, non-friable, and suspect ACBM in routine access or maintenance areas to alert and remind facility occupants not to disturb ACBM. All boilers, pipes, and equipment with ACBM in accessible locations will be tagged with warning labels for the same purpose. The label will be sufficiently visible as far as size, color, and print so that it may be easily read. It shall read:

**CAUTION: ASBESTOS. HAZARDOUS.
DO NOT DISTURB WITHOUT PROPER
TRAINING AND EQUIPMENT.**

In lieu of labels, informational signs may be posted in areas where the placing of labels is not feasible. The informational sign should reference the asbestos-containing building material. These signs should be used to inform maintenance and custodial staff, building staff and outside contractors of the locations of ACBM. The following is an example of an informational sign for asbestos-containing floor tile. The sign should be placed in work areas on a wall, support column or any other location that can be easily identifiable, and read as follows:

**CAUTION: ASBESTOS-CONTAINING FLOOR TILE. HAZARDOUS.
DO NOT DISTURB WITHOUT PROPER
TRAINING AND EQUIPMENT.**

7.2 Building Visitors, Contractors, Workers, and the Public

EPA and OSHA regulations require notification to all building occupants and outside contractors of the presence of ACBM. This notification requires providing details on the location of the Asbestos Management Plan which contains the locations of ACBM and informing them of their need to avoid disturbing the materials. In addition, contractors scheduled to perform work at the facility should review this O&M plan and sign the Contractor Notification and Agreement form, attached in Section 5.9.3 of this plan, prior to commencing work.

7.3 Methods of Informing Others

Facility occupants will be informed of asbestos associated hazards by one or a combination of the following four methods: 1) distributing written notices and letters; 2) posting signs where appropriate; 3) labeling ACBM, and 4) holding awareness or informational sessions. Information sessions are intended to reinforce and clarify written notices and signs, and to provide

individuals an opportunity to ask questions. All employees are to be included in the notification program on a continuing basis. New employees will be informed and / or trained within 60 days of beginning work. All employees will attend an annual information seminar which will discuss the status of the ACBM in the building. Training classes and sessions, and labeling and placarding ACBM materials are discussed within this O&M plan.

8.0 - - - O&M ACTIVITIES AND OPERATIONS

Postal employees must not work with ACBMs if the activity might reasonably be expected to release asbestos fibers. Routine cleaning and maintaining of non-friable materials, e.g., vinyl tile, asbestos floor tiles, and asphalt plank are permissible as long as these cleaning procedures follow specific guidelines (OSHA Class IV asbestos work). In addition, limited hole drilling in resilient flooring (OSHA Class III asbestos work) is also permissible provided employees performing this work have successfully undergone a minimum of 16 hours of Asbestos Operations and Maintenance training and follow the procedures outlined in Appendix A of this O&M Plan.

ALL OTHER MAINTENANCE, REPAIR, CLEAN UPS, ALTERATIONS, RENOVATIONS, OR REMOVALS THAT RELEASE OR RE-ENTRAIN ASBESTOS FIBERS MUST BE ACCOMPLISHED BY QUALIFIED CONTRACTORS. ACCREDITED INSPECTORS OF THE USPS EMPLOY HOWEVER, MAY CONDUCT BULK SAMPLING OF SUSPECTED ACBMs.

8.1 Resilient Floor Care and Custodial Activities

Sanding of asbestos-containing flooring is not permitted. **Only stripping of floor coating must be conducted with low abrasion pads at speeds less than 300 RPM and wet methods. According to OSHA, burnishing speeds are not restricted, but sufficient finish must be present, e.g. 3 layers of wax coating, so that the pad cannot contact the asbestos-containing material.** Dust and debris in an area containing TSI or surfacing ACM or PACM shall not be dry dusted or swept, or vacuumed without using a HEPA filter.

8.2 Small - Scale, Short Duration Repair and Abatement Activities

The manipulation or removal of small amounts of ACBM require custodial and maintenance personnel who have received the additional 16-hour training program. Their activities fall under the small - scale, short duration projects described in Appendix B to subpart E of 40 CFR 763. All work will be performed in accordance with all requirements and provisions as stated in US EPA 40 CFR part 61 subpart M; US DOL OSHA 29 CFR 1926.1101; US DOL OSHA 29 CFR 1910.134; US EPA 40 CFR part 763 subpart E; US EPA 40 CFR 763 subpart G; US DOT 40 CFR 763 subpart J. Moreover, all patching or repairing of accidentally damaged ACBM should be delayed until the material has been assessed at the direction of the Asbestos Program Manager.

8.3 Potential for Accidental Disturbance

Maintenance activities which may cause accidental disturbance of ACBM will be performed by personnel having asbestos maintenance training in at least the more extensive 16-hour asbestos training program. Although disturbances may be accidental and therefore unlikely, these personnel must be trained in proper response actions and be much more aware of the potential impact of their activities. Example: Maintenance activities in this category include replacing light bulbs in a ceiling that contains friable ACBM. Avoid patching or repairing any accidentally damaged ACBM until it is assessed at the direction of the Asbestos Program Manager.

8.4 Emergency Response Actions - Fiber Release Episodes

Each emergency response to an asbestos fiber release situation will be pre-determined and individualized by those persons in charge of each U.S. Postal Facility. Any emergency response actions involving either type of fiber release episodes should be performed by an EPA trained asbestos abatement contractor. Fiber release episodes are described below.

8.4.1 Major Fiber Release Episode

Major Fiber Release Episodes are the unintentional and uncontrolled disturbance or release of large amounts of ACBM (greater than 3 square or linear feet). Major fiber release episodes are serious events. Unintentional or uncontrolled releases of ACBM falling from heights of several feet may contaminate an entire building with asbestos fibers. All USPS personnel (including maintenance and administrative staff) should first isolate the area and immediately report the presence of any damaged ACBM, or any other evidence of possible fiber release to the Asbestos Program Manager.

8.4.2 Minor Fiber Release Episode

Minor Fiber Release Episodes are limited to three square or linear feet or less of ACBM that has been disturbed, accidentally, without proper Work Controls having been implemented. All USPS personnel (including maintenance and administrative staff) should first isolate the area and immediately report the presence of any damaged ACBM, or any other evidence of possible fiber release to the Asbestos Program Manager.

8.5 Maintenance and Renovation Activities

The procedures described below are to protect building occupants and are applicable to all O&M activities that may involve disturbing ACBM: ***They are mentioned in this plan for information purposes only and shall not be performed by USPS personnel.***

A. Restrict entry into the area by persons other than those necessary to perform the maintenance project, either by physically isolating the area or by scheduling.
B. Post signs to prevent entry by unauthorized persons.
C. Shut off or temporarily modify the air handling system and restrict other sources of air movement.
D. Use work practices or other controls, such as wet methods, protective clothing, HEPA vacuums, mini-enclosures, glove bags, as necessary to inhibit the spread of any released fibers.
E. Clean all fixtures or other components in the immediate work area.
F. Place the asbestos debris and other cleaning materials in a sealed, leak-proof container which is visibly labeled as asbestos waste. Double bagging is required.

O&M maintenance practices are tailored to the likelihood and severity of ACBM disturbance and potential for exposure of workers and other building occupants to airborne asbestos fibers. Projects involving the disturbance of ACBM are limited by this O&M program to activities falling into the OSHA Asbestos Construction Standard categories of Class III and Class IV Asbestos Work discussed in subsequent subsections e.g., routine cleaning and maintenance of non friable materials. These activities are described below. They are considered low potential for fiber release or asbestos fiber contact.

Subsequent paragraphs describe activities of a higher potential for accidental disturbance and the actions which may be performed by contractor or other personnel having asbestos training more extensive than the 16 hour asbestos training program.

9.0 SAMPLE FORMS FOR ASBESTOS-CONTAINING BUILDING MATERIAL

9.1 ACBM Activity Record Form
(See Next Page)

RECORD OF ASBESTOS EVENTS

To be used to record changes in ACBM disposition (e.g., abatement of floor tile, abatement of ceiling, etc.)

U.S. POSTAL SERVICE FACILITY: _____

LOCATION: _____

ASBESTOS PROGRAM MANAGER: _____

DATE	TYPE OF MATERIAL	DESCRIPTION OF ACTIVITY

Postal employees must not work with ACBMs if the activity might reasonably be expected to release asbestos fibers. Routine cleaning and maintenance of nonfriable materials, e.g., vinyl tile, asbestos floor tiles, and asphalt planking, are permissible following these specific guidelines. However, ALL MAINTENANCE, REPAIRS, AND CLEAN UPS, ALTERATIONS, RENOVATIONS, OR REMOVALS THAT RELEASE OR RE-ENTRAIN ASBESTOS FIBERS MUST BE ACCOMPLISHED BY QUALIFIED ASBESTOS CONTRACTORS. ACCREDITED INSPECTORS, HOWEVER, MAY CONDUCT BULK SAMPLING OF SUSPECT ACBMs.

9.2 Sample Fiber Release Report
(See Next Page)

FIBER RELEASE EPISODE REPORT

A suggested report form for a fiber release episode

1. Address, building, and room number(s), (or description of area) where episode occurred:

2. The release episode was reported by _____ on _____ _____ (date).

3. Describe the episode:

4. The asbestos-containing building material was __/was not __ cleaned up according to approved procedures. Describe the cleanup:

SIGNED:_____ DATE: _____
(Asbestos Program Manager)

9.3 Contractor Notification Agreement Form
(See Next Page)

CONTRACTOR NOTIFICATION AND AGREEMENT FORM

This notice is to all trades who perform work in the building (_____) that asbestos-containing building materials have been identified within the building. A listing of such material and their locations is found in the Asbestos Program Manager's Office (Asbestos Operations and Maintenance Plan) (Location: _____ phone: _____). If the contractor has any questions with respect to the Operation and Maintenance (O&M) Plan or asbestos-containing building materials (ACBM), then he/she should contact the Asbestos Program Manager of the regional office.

By signing this agreement, the Contractor acknowledges that he/she is aware of the hazards and liabilities associated with work in area where ACBMs are present. The Contractor further acknowledges that he/she has reviewed and will comply with the O&M Plan, has inspected the work area(s), that there are no damaged ACBMs present in the work area(s), and that all ACBMs will be left in a clean/undamaged condition throughout all work activities. If upon commencing or after commencing work the Contractor encounters a situation involving ACBMs that he/she is not trained to handle, he/she shall notify the Asbestos Program Manager or delegate that he/she is not authorized to do the work and shall not do the work. The Contractor agrees that he/she and/or his/her employees shall not disturb known or suspect ACBMs as identified in the O&M Plan for the building in question, and shall follow applicable procedures outlined in the O&M Plan. Any damage of ACBMs shall be reported to the Asbestos Program Manager immediately. The Contractor is aware that Federal and State regulations require that only properly licensed and trained personnel perform activities that may disturb asbestos materials. The Contractor shall not use or install any asbestos-containing building materials in the building.

By signing this agreement, the Contractor agrees to indemnify and hold harmless the Building Owner (United States Postal Service), and the Owner's Consultant (Espey, Huston & Associates, Inc.), from all liability, claims, damages and costs, including attorney's fees of every kind and nature and attributable to bodily injury, sickness, disease or death or to damage or destruction of property, resulting from or in any manner arising out of or in connection with the Contractor's work. It is also understood and agreed that the Contractor, in case of damage to or disturbance of any asbestos resulting from the Contractor's work (or subcontractors employed by him), the Contractor shall be liable for any and all expenditures incurred to decontaminate and/or replace, repair, or rebuild the damaged or destroyed property to the equivalent size, kind, and quality that existed prior to the loss, in accordance with Federal, State and Local laws and regulations relating to asbestos and other hazardous materials. The Contractor guarantees that his/her employees have reviewed this form and agree with its contents.

Location of work (address): _____

Description of work: _____

_____

_____

I/We have read and understand the above Notification & Agreement Form, as of _____, 19 ___

Name of Company: _____

Contractor Authorized Signature: _____

Title: _____

9.4 Asbestos Abatement Contractor Release Form
(See Next Page)

LICENSED ASBESTOS ABATEMENT CONTRACTOR RELEASE FORM

By signing this form, the asbestos abatement Contractor acknowledges that he/she has reviewed the asbestos Operations and Maintenance (O&M) Plan for this property, has prepared a work plan/specification for the abatement or repair project, has inspected the work area(s) and is properly licensed and trained in accordance with all applicable Local, State and Federal laws and regulations to perform the work.

By signing this agreement, the Contractor agrees to indemnify and hold harmless the Building Owner (United States Postal Service), and the Owner's Consultant (Espey, Huston & Associates, Inc.), from all liability, claims, damages and costs, including attorney's fees of every kind and nature and attributable to bodily injury, sickness, disease or death or to damage or destruction of property, resulting from or in any manner arising out of or in connection with the Contractor's work. It is also understood and agreed that the Contractor, in case of damage to or disturbance of any asbestos resulting from the Contractor's work (or subcontractors employed by him), the Contractor shall be liable for any and all expenditures incurred to decontaminate and/or replace, repair, or rebuild the damaged or destroyed property to the equivalent size, kind, and quality that existed prior to the loss, in accordance with Federal, State and Local laws and regulations relating to asbestos and other hazardous materials. The Contractor guarantees that his/her employees have reviewed this form and agree with its contents.

Location of work (address): _____

Description of work: _____

_____

_____

I/We have read and understand the above Release Form, as of _____, 19 ____

Name of Company: _____

Contractor Authorized Signature: _____

Title: _____

10.0 - - - MONITORING THE CONDITION OF ACBMS

10.1 Periodic Surveillance of ACBMs

Periodic surveillance or monitoring is a key aspect of this O & M program. Ongoing monitoring and reports on the changes in the condition of the ACBM will be made by designated staff, and occupants, who will ensure that any damage or deterioration of the ACBM will be detected without delay so that corrective action(s) can be taken. Periodic inspections will be conducted at least semi-annually and more frequently if necessary by personnel trained in the identification and assessment of ACBM. Either the Asbestos Program Manager or someone trained and experienced in ACBM assessment should conduct the surveillance. A visual inspection will be performed of all areas that have been identified as having ACBM or suspected ACBM, and document in writing the date of the surveillance, observations of changes in conditions, and a signature of the inspector. Photographs of the material may be taken as part of this surveillance. The results of the periodic surveillance must be documented, reviewed, and reported, using the "ACBM Activity Record Form" found in Section 9.1 of this plan, and placed in the management plan held by the Asbestos Program Manager, for each affected facility.

Air monitoring may be recommended as a supplement to periodic visual inspections depending on the friability, condition, and placement of the ACBM. If air monitoring is conducted, transmission electron microscopy (TEM), not phase contrast microscopy (PCM), should be used to count and identify airborne fibers. Only TEM can detect and quantify the majority of microscopic asbestos fibers typically found in buildings containing airborne asbestos fibers. Large scale disturbance of ACBM will release larger amounts of fibers detectable by Phase Contrast Microscopy (PCM). Such monitoring is also required in conjunction with clearance sampling for response actions.

10.2 Reinspection of ACBMs

Complete reinspection and updating of the Management Plan is recommended every three years (as a minimum) after a management plan is in effect. This requirement applies to all ACBM known or assumed in each facility building that is leased, owned, or otherwise used as a Postal Facility. Each inspection shall be made by an accredited inspector who:

A. Visually reinspects and reassesses under 40 CFR Part 763.88 the condition of all friable, known, or assumed ACBM;
B. Visually inspects and touches material that was previously considered non-friable ACBM to determine whether it has become friable since the last inspection or reinspection;
C. Identifies any homogenous areas with material that has become friable since the last inspection or reinspection. For each homogenous area of newly friable material that is already assumed to be ACBM, bulk samples must be collected and submitted for analysis in accordance with 40 CFR Part 763.86 and 763.87;
D. Assesses, under 40 CFR Part 763.88, the condition of the newly friable material in areas where samples are collected, and in areas that are assumed to contain ACBM;

E. Reassesses, under 40 CFR part 763.88, the condition of friable known or assumed ACBM previously identified;

F. Records the following and submits to the Asbestos Program Manager or the Postal Services duly authorized person, a copy of the reinspection report for inclusion in this management plan within 30 days from the date of the reinspection: (1) The date of reinspection, the name and signature of the persons making the reinspection, State of accreditation and accreditation number, and any changes in the condition of known or assumed ACBM; (2) the exact location where samples are collected during the reinspection, a description of the manner used to determine sampling locations, the name and signature of each accredited inspector who collected the samples, State of accreditation, and his or her accreditation number; (3) any assessments or reassessments made of friable material, the name and signature of the accredited inspector making the assessments, State of accreditation, and his or her accreditation number.

11.0 SITE SPECIFIC ACBM

The known and assumed ACMs identified in this building are summarized in Table H-1. If any additional asbestos inspections are performed by the USPS, this section will be updated to reflect this new information.

Note: Additional precautions will need to be taken with respect to abrasive cleaning of the floor tiles. Specifically, any floor stripping must be accomplished with low abrasion pads at speeds less than 300 RPM, and wet methods are utilized during the entire activity. No sanding is permitted. Burnishing and dry-buffing can only be conducted on floors with sufficient finish (i.e., three layers of wax/coating according to OSHA).

TABLE H-1
Summary of Known and Assumed ACMs
Located at Lexington Main Post Office

Known Asbestos-Containing Materials

Material Description	Condition of the Material	Location of Material	Amount of Material
9"x9" green floor tile	Good Good Good Good	Storage Conference room Inspector's office Restroom	400 ft^2 320 ft^2 220 ft^2 42 ft^2
Insulation on 2" line	Good	Attic	30 lf

Assumed Asbestos-Containing Materials

Material Description	Condition of the Material	Location of Material	Amount of Material
Roofing materials	Unknown	Roof	6,100 ft^2

Note: Because of the complexity of the building, all ACBMs may not have been identified in the asbestos survey of the building. If any suspect materials are encountered during any maintenance activities, these materials should not be disturbed. Notify the Asbestos Program Manager so that a determination can be made as to whether these materials contain asbestos. If it is unclear if these materials contain asbestos, additional bulk sampling for asbestos may be required. If bulk sampling is not conducted, the material will be assumed to contain asbestos.

12.0 O&M WORK PRACTICES

The contents of this section include the guidelines for cleaning, maintenance, repair and response action activities and step by step procedures for performing work activities that involve the asbestos-containing materials identified at this facility. This section is constructed so that the checklists, forms and procedures can be removed from the O&M program, copied and used for the maintenance activity.

O&M Work Practices

General This *Guidance Manual: Asbestos Operations and Maintenance (O&M) Work Practices* has been prepared to provide guidance on worker protection, basic O&M procedures, O&M cleaning practices, and procedures for responding to minor asbestos fiber release episodes in facilities with asbestos-containing material (ACM).. This manual has been prepared by a National Institute of Building Sciences' (NIBS) committee under an assistance agreement between NIBS and the U.S. Environmental Protection Agency (EPA) and the General Services Administration (GSA). The project committee has prepared the manual following the rules of the NIBS consensus process. This process provides an opportunity for representatives from all sectors of the building community to participate in the development and approval of the document.

The NIBS Consultative Council through its Operations Committee has approved the composition of the project committee for balanced representation and expertise, and has provided oversight of the project activities to insure conformance with the NIBS consensus process and has accepted the final report of the project committee.

Scope and Flexibility The work practices are intended to assist in meeting the current OSHA regulations applicable to O&M work. Appendix B of EPA regulation 40 CFR 763, Subpart E discusses work practices and engineering controls for small-scale, short-duration renovation and maintenance activities involving asbestos-containing materials.

For the purpose of the USPS, projects larger than small-scale, short-duration should be performed by licensed and experienced asbestos abatement contractors. If ACM is in poor condition, O&M might not be appropriate and abatement might be necessary. These O&M work practices are not to be used for activities requiring abatement of ACM.

This manual is intended for use by an Asbestos Program Manager (APM) and trained workers. The title "Asbestos Program Manager" is used throughout; however, other titles can be used by individuals holding similar responsibilities. The manual provides checklists and step-by-step work practices which might be used by an APM and workers for performing O&M work. Because asbestos in buildings is present under widely varying circumstances including, but not limited to, its condition, location, material type, friability, and accessibility, a range of guidance for common operations and maintenance procedures is offered in this manual. The project committee determined that flexibility is crucial to the efficient and cost effective completion of an O&M activity. This leaves the ultimate choice of methods to on-site personnel who have first-hand knowledge of the asbestos material, facility conditions, and other pertinent needs. These work practices were written with the knowledge that there might be alternate procedures or equipment beyond those in this manual that will adequately accomplish O&M objectives. The project committee encourages the development and application of new and innovative equipment and safe, cost effective procedures for O&M work. The work practices included in the manual are based on practices known to the committee. Many of these work practices were in use when the manual was written. Data indicating that these work practices perform as intended is not available for many of the work practices. These work practices are not the only successful methods currently available or in use, but were judged by the committee to be applicable to a wide range of common situations. Preventative measures that provide protection for undamaged ACM might be installed in conjunction with the O&M activities covered by this manual. Different recommendations, referred to as levels, of the same work practice are provided to accommodate for variations in the type and condition of the asbestos-containing material to be worked on, the building conditions in which the ACM is located, and the skill level of workers. It is assumed that varying conditions

will require different work practice levels to accomplish the same basic task. Selection of the appropriate levels of work practices should be made by the APM for a specific building based upon the conditions in that building. Risk assessments and liability concerns might also influence the selection of the level for a specific work practices.

Assumptions The manual has been developed on the assumption that all asbestos O&M work at a minimum will be done in accordance with applicable regulations by persons trained in asbestos in general and O&M methods in particular. It is important to emphasize that this is a guidance document only, and is not now, nor ever intended to be used for regulatory purposes. In fact, because on-site circumstances are often sufficiently unique in small scale, short duration settings to defy rigid control prescriptions, any attempt to use it for regulatory purposes is inappropriate. This manual is not intended to supplant work practices already in place and being successfully applied.

Likewise, it must be emphasized that users of this manual might wish to modify (in compliance with applicable regulations) the guidance provided here to suit their unique circumstances. For example, as stated elsewhere, users might wish to alter the recommended forms included in the manual to accommodate their operations and circumstances, or modify work practices based on data from past work, new equipment developments or other unique situations. This manual offers guidance only. The user must verify the success of whatever work practices are used. The development of innovative and creative new equipment and procedures that work safely and effectively for performing O&M activities is encouraged.

Related Documents This manual is intended to be used in conjunction with the guide *Managing Asbestos in Place ("Green Book")* issued by the EPA in July, 1990, and in compliance with all applicable federal, state and local regulations. The *Green Book* explains the objectives and administrative procedures for an O&M Program. This O&M Work Practices Manual provides detailed procedures for conducting O&M work involving ACM, such as maintenance, repair and minor renovation work. It is expected that many decisions relating to work practice levels might be embodied in the O&M plan for a specific building. In some circumstances, governing regulations may dictate level selection. Information presented in the Green Book is not repeated in this guide but is referenced where appropriate. Additional references might be made to other legal regulations and guidance documents, including:

Statutory & Regulatory Requirements

1. OSHA's asbestos construction, construction safety, personal protection and hazard communication standards
2. National Emission Standards for Hazardous Air Pollutants (NESHAP)
3. Asbestos Hazard Emergency Response Act (AHERA)
4. Asbestos Schools Hazard Abatement Reauthorization Act (ASHARA)
5. EPA Worker Protection Rule (WPR)
6. Department of Transportation's hazardous waste transportation standards

EPA Guidance Documents

1. Asbestos in Buildings: Simplified Sampling Scheme for Friable Asbestos Materials ("Pink Book")
2. Guidance for Controlling Asbestos-Containing Materials in Buildings ("Purple Book")
3. A Guide to Respiratory Protection for the Asbestos Abatement Industry ("White Book")

Generally accepted good construction work practices should be used for all other aspects of O&M activities not specifically mentioned in these work practices.

O&M Work Practices

General The EPA Green Book provides building owners, managers, workers and other building staff with basic information on how to develop and carry out operations and maintenance programs.

The O&M work practices in this manual are designed to provide detailed and specific guidance to the O&M personnel for conducting maintenance, repair and minor renovation work in accordance with an established asbestos O&M program and applicable regulations. The work practices in this manual are designed to reduce or contain materials, dust, or fiber release resulting from work performed on or near asbestos-containing materials. The work practices are also intended to minimize the extent and impact of any releases which do occur. Summaries of each work practice and examples of typical situations that might be encountered are included to assist in the selection of appropriate work practice levels.

This manual presumes that an O&M program is, or will be, established. The work practices in the manual address most commonly encountered operations and maintenance tasks involving asbestos-containing materials. This manual is not exhaustively complete and does not document or establish a defined procedure for every possible situation. The manual is formatted to present an array of actual conditions which might be encountered. It establishes a logical path to be followed in selecting the most appropriate work practice(s) for a given situation. Building workers are often very familiar with actual building conditions and might provide valuable input to the design of O&M work. Workers might also wish to offer suggestions for modifications to specific work practices. Any changes to the work practices should be reviewed with the APM.

As a part of the O&M program, the Asbestos Program Manager (APM) should review building inspection information to determine whether or not a suspect material contains asbestos. If a suspect material which is to be worked on has not been sampled, it should either be sampled and analyzed in accordance with the EPA Pink and/ or Purple Books, or be assumed to contain asbestos and treated accordingly.

If work practices from this manual are incorporated into an existing O&M program, the entire O&M program should be reviewed and updated, if necessary. Building renovation, maintenance or repair work that does not directly affect ACM might necessitate revisions to an O&M program if pertinent factors, such as accessibility to ACM, are altered.

O&M Program Assumptions This O&M Work Practices Manual assumes that all elements of an O&M program listed below are considered and applicable elements are established.

- Asbestos Program Manager appointment and training
- Building inspection and assessment
- Written building-specific O&M program
- Copies of applicable regulations and guidance documents
- Occupant notification/communication program
- O&M worker, supervisor, and competent person assignments and training program
- Work control/inspection/permit system
- Periodic surveillance program
- Recordkeeping program
- Hazard communication program
- Worker protection program (personal protective equipment)
- Respiratory protection program
- Medical surveillance program
- Asbestos fiber release episode response program
- Air monitoring program
- Waste disposal program
- Historical air monitoring data
- Confined space program
- Safety program for other hazards

All O&M related programs should be reviewed periodically and revised if necessary. Regulatory and guidance documents should also be reviewed periodically to ensure that they are current.

Organization of Work Practices The O&M work practices in this guide are grouped according to the type of asbestos-containing materials (ACM) that will be affected by the work. ACM is classified in this manual according to the three (3) categories used by the EPA. This classification system has been widely used in the asbestos industry since the publication of the Asbestos Hazard Emergency Response Act Rules (AHERA) in 1987. These categories are:

1. **Surfacing Materials** - materials sprayed or troweled onto building surfaces, such as acoustical materials or fireproofing.
2. **Thermal Systems Insulation (TSI)** - pipe, boiler, tank, duct and other insulation applied to components to reduce heat loss, heat gain or condensation.
3. **Miscellaneous Materials** - materials such as floor tile, ceiling tile, roofing, cement asbestos products and other materials that are not included in categories 1 or 2 above.

The work practices in this manual are generally designed to address one material at a time. If more than one type of material is involved, work practices should be selected and used in the order in which the materials will be encountered during the work. If two (2) or more materials must be addressed at one time, the Asbestos Program Manager should develop a combined Work Practice to address the particular work situation.

When developing a combined work practice, the APM should consider the following:

1. The checklist for the ***most precautionary level of work practice*** should be used.
2. The work area should be prepared in accordance with the checklist for the ***most precautionary level of work practice*** being used.
3. Once the work area is prepared and pre-work activities are complete, the detailed work practices should be performed in the order in which materials are encountered.
4. Clean up and tear down procedures should also follow the ***most precautionary level of work practice*** being used.

Work practices in this manual need to be validated and/or modified for the facility where O&M work will be performed. When work is to be performed, the final work practices should be given to workers along with other referenced O&M forms. Repetition of certain steps in different work practice levels is intentional in order to provide consistent and complete information to a worker for a given work practice level.

Work Practice Levels Up to three levels are included for each work practice to address different degrees of potential asbestos fiber exposure. The levels are simply a means of structuring the guidance which the manual provides. The NIBS project committee judged that three levels were sufficient to encompass a broad range of situations which are likely to be encountered. A different number of levels might be selected by an APM or designed into a specific asbestos O&M program. USPS personnel may only perform Level 1 Work Practices with one exception - MC Level 2 "Penetrating Resilient Asbestos Flooring and/or Subflooring".

A change of level does not imply a different task to be accomplished. It implies a changed potential for asbestos fiber exposure, typically related to either the condition of asbestos or the building context in which the task will be performed.

The levels for each work practice included in this manual were selected by the project committee through the NIBS consensus process to represent readily identifiable and appropriate levels. Examples are provided to assist users in selecting appropriate levels for specific building conditions. Higher levels become more protective and hence more difficult, time consuming and costly to implement. Three levels are not provided for every work practice.

If a work practice level is not included, it was deemed unlikely to be encountered under typical conditions. An appropriate work practice level must be selected or created by the Asbestos Program Manager for each O&M activity that will occur in a facility.

The three work practice levels are defined as follows:

Level 1: *Work practice is usually intended to avoid a disturbance of ACM and release of asbestos fibers, but if ACM is disturbed, it is likely that worker and building occupant exposures will be minimal.*

Level 2: *Work practice is likely to, or intended to, disturb small amounts of ACM for short periods of time. Worker protection and localized engineering controls are justified, but the disturbance is unlikely to create building occupant exposure or impact the building environment.*

Level 3: *Work practice is intended to disturb small amounts of ACM in ways sufficient to justify engineering controls, and protection of workers, building occupants and the building environment.*

A "disturbance" of ACM, as used in the level definitions, refers to any activity that disrupts the matrix of ACM, or generates visible debris, or disturbs visible debris.

Figure 1, which follows, summarizes the engineering controls and practices recommended for each level. The APM should determine the appropriate level, based on the O&M program objectives, the O&M program elements, and level of training needed for each level of work practices used in a facility.

Figure 1: Guidelines for 3 Levels of Work Practices

ITEM *(General Procedure Reference)*	***LEVEL 1***[1]	***LEVEL 2***[1]	***LEVEL 3***[1]
Fiber Release Potential	Low/Minimal[1]	Moderate	High
Training *(APM5)*[2]	Awareness/O&M[3]	O&M	O&M
HVAC System Off *(W3)*	NO[4]	YES	YES
Vacate Area *(W4, APM2)*	NO	YES	YES
Critical Barriers *(W4)*	NO	NO[5]	YES
Delineated Work Area *(W4)*	NO	YES	YES
Respiratory Protection *(W5)*	NO[6]	YES[7]	YES
Protective Clothing *(W6, W14)*	NO[8]	YES	YES
Initial Monitoring *(W7)*	NO[9,10]	YES[9,10]	YES[9,10]
Periodic Monitoring *(W7)*	NO[10]	YES	YES
Preclean *(W8)*	NO	As Needed[11]	As Needed[11]
Use HEPA Vacuum *(W8)*	As Needed[11]	YES	YES
Wet Methods *(W8)*	As Needed[11]	YES	YES
Work Area Protection *(W9)*	NO[12]	Drop Cloth, Glovebag	Mini-Enclosure, Negative-Pressure System[13]
Local HEPA Exhaust *(W9)*	NO	As Needed[11]	As Needed[11]
Lockdown *(W10)*	NO	YES[11]	YES[11]
Area Decontamination *(W11)*	NO	YES	YES
Visual Inspection *(W12)*	NO	YES	YES
Air Clearance *(W12)*	NO[14]	NO[14]	YES
Personal Decontamination *(W15)*	NO[15]	YES	YES

NOTES

1 The exact meaning of these three levels will vary depending upon the exposure objectives which are specified in the design of the O&M plan for a specific building (see Design & Validation of An O&M Plan for further explanation). State and local requirements may be more stringent than these guidelines.

2 The general procedures in parentheses provide additional information on the noted item.

3 Training should be appropriate to the type of ACM, building conditions, and the work to be performed. If ACM may be or will be disturbed, O&M training may be necessary.

4 Turn off HVAC if work will be performed on HVAC system(s).

5 Critical barriers may be necessary or be required for specific cases by the APM.

6 The OSHA asbestos standard, Appendix G, states that maintenance staff employees should be instructed not to remove ceiling tiles below ACM without wearing the proper respiratory protection, clearing the area of other people, and observing asbestos waste disposal procedures. Appendix E of the Green Book recommends that respirators be worn for routine maintenance work where there is a reasonable likelihood of ACM disturbance. For routine maintenance work where contact with ACM is unlikely, appendix E recommends "No respiratory protection required. (Air-purifying respirators with high-efficiency filters should be available if needed; half-face or full facepiece)." EPA advises building owners that these recommendations go beyond OSHA requirements.

7 Respiratory protection can be deleted if supported by adequate exposure data in accordance with the OSHA regulations.

8 Protective clothing should be available and is required by OSHA if exposure is over permissible exposure limit.

9 Monitoring is required by OSHA if ACM is disturbed.

10 Monitoring may be deleted if supported by statistically reliable historical data in accordance with OSHA regulations.

11 May be recommended - see work practices. Adequate training is necessary.

12 Drop cloth optional for dirty tools, equipment and/or waste.

13 Work area protection may be revised if alternate methods are used and historic data are available.

14 Air clearance depends on air monitoring program requirements.

15 Personal decontamination may be required by APM or O&M program.

Figure 2: Work Practice Selection

Asbestos Program Manager Tasks:

Work Practice Selection and Use

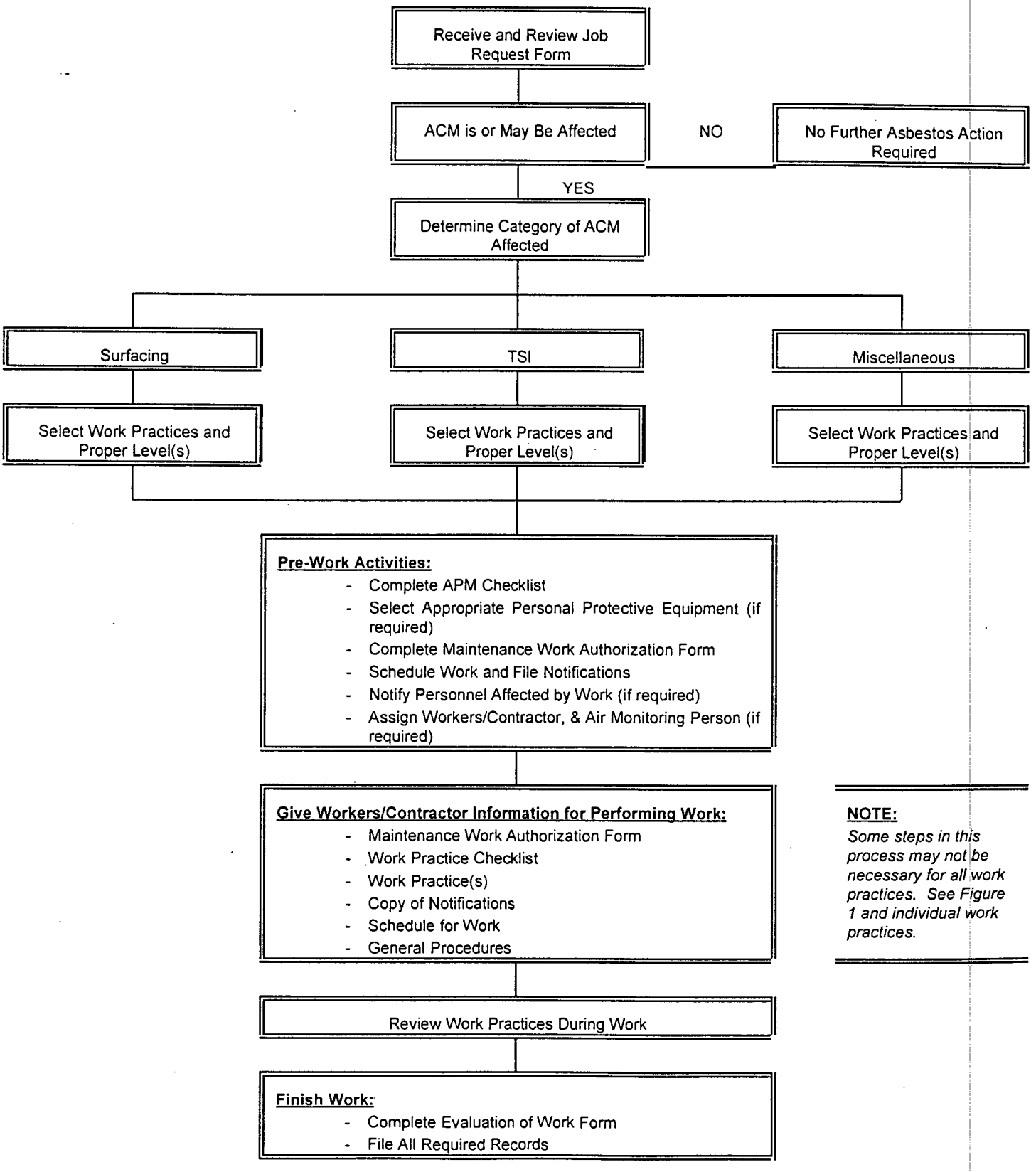

Figure 3: APM Checklist

Asbestos Program Manager (APM) Checklist for Operations and Maintenance Work Practice Use

- ☐ Receive and review Job Request Form

  Work to be performed:

  _____

  _____

- ☐ Review or request survey data to determine whether ACM is affected.
- ☐ Complete Maintenance Work Authorization Form, including:
  - ☐ Review historical air monitoring data for work practices to be used.
  - ☐ Work Practice(s) selected for all ACM to be encountered.
  - ☐ Select personnel protective equipment and decontamination requirements to be used.
  - ☐ Select appropriate materials and review potential hazards (confined spaces, scaffold use, etc.).
- ☐ Schedule work when area is not in use or plan developed to isolate area (if necessary).
- ☐ Federal, state and local notifications filed (if applicable).
- ☐ Notify personnel affected by work.
- ☐ Assign workers (or contractor) with appropriate level of training. Verify currency of training, fit tests, and medical surveillance.
- ☐ Assign trained air monitoring person and determine air monitoring to be performed (if needed). Record air monitoring requirements on Maintenance Work Authorization Form.
- ☐ Provide copies to workers/contractor of:
  - ☐ Maintenance Work Authorization Form
  - ☐ Work practice checklist for proper work level.
  - ☐ Work practice(s): _____
  - ☐ General Procedure(s)
  - ☐ Notifications
  - ☐ Schedule of work
- ☐ As practical, review work practices during work for compliance with requirements and worker general procedures.
- ☐ Complete Evaluation of Work Affecting ACM form.
- ☐ File all required records in proper files.

Signature: _____ **Date:** _____

Worker General Procedures

W-1

Tools, Equipment and Materials The following is a list of tools, equipment and materials that are referenced in the work practices and are recommended to perform the work practices. Tools, equipment or materials that are unique to a certain work practice are listed under item 2 in each work practice. For frequent O&M work, it might be helpful to maintain an "O&M cart" containing the necessary tools, equipment and materials.

Tools and Equipment

- Utility knife
- Ground fault circuit interrupters (GFCI's), Extension cords and adapters - GFCI's should be used on any electrical equipment or tools used in O&M work where water might be in use or present in the work area.
- Lockout tags
- Temporary work lights
- Ladder or scaffold for elevated work
- Wet wipes or bucket with clean water for wet wiping
- Wire cutters
- Tin snips
- Safety glasses

Abatement Equipment and Materials

- Polyethylene sheet
- Duct tape
- Disposal bags with labels
- High efficiency particulate air (HEPA) vacuum with hose, attachments and proper HEPA filter (wet/dry type needed for some work practices)
- Respirators (if required)
- Disposable coveralls (if required)
- Disposable towels or wet wipes
- Asbestos barrier tape
- Warning signs
- Garden sprayer with amended water or removal encapsulant (Level 2 and 3 practices) See general procedure W2.
- Aerosol cans or garden sprayer with lockdown encapsulant (Level 2 and 3 practices)
- Air monitoring pumps, cassettes and calibration equipment (if required)

W-4

Securing Work Area When asbestos fibers might be released, work areas should be vacated and secured (where feasible) by scheduling, locking doors (from inside the area if possible) or other means. Installing polyethylene critical barriers over all openings into the work area. If this is not feasible, access to the work area should be restricted, such as by asbestos barrier tape around the perimeter of the work area. If barrier tape is used to denote a work area, it should be placed 5 to 10 feet (1.5 to 3 meters) outside of any polyethylene protection used in the work area. Install barrier tape by taping or tying it to fixed objects.

Do not block access to any emergency exits, and when asbestos fibers might be released, post OSHA required "danger" signs at all entrances to the work area. For such projects, it might be desirable to have a visual barrier installed several feet in front of warning signs to avoid having warning signs readily visible to occupants. A "keep out of construction area" sign should be posted on visual barriers. A visual barrier would be arranged so that a person who goes past the visual barrier will then see required warning signs.

W-8

Precleaning Work Areas and Wet Wiping

Precleaning of work areas prior to the start of work is done to remove accumulated debris that could be disturbed during the work. Precleaning might include picking up dust and debris with a HEPA vacuum, wet wiping non-porous surfaces, HEPA vacuuming surfaces that cannot be wet wiped, and cleaning any carpeted surfaces using steam extraction equipment. Precleaning might reduce the extent of cleaning required after the work and for clearances (if required).

Wet Wiping The procedures to be used for wet wiping are as follows:

1. Immerse disposable towel in bucket containing amended water.
2. Wring out towel and fold into quarters.
3. Wipe surface and refold to have a clean face exposed. Do not place towel back into bucket or water will become contaminated and will need to be replaced.
4. Repeat step 3 until all faces of towel have been used. Obtain a clean towel if more wiping is needed.
5. Dispose of used towels in disposal bags.
6. Dispose of contaminated water as required by applicable regulations -*See general procedure W18.*

HEPA Vacuuming The procedures to be used for HEPA vacuuming are as follows:

1. For floors, use a floor attachment with rubber floor seals and adjustable floor-to-attachment height. For furniture, fabrics or other surfaces use an upholstery attachment or brush attachment.
2. Vacuum hard or smooth surfaces with attachment about 1/16" (2 mm) above the surface.
3. Vacuum carpet or fabrics with attachment just touching the surface.
4. Vacuum all surfaces in parallel passes with each pass overlapping the previous one by one-half the width of the attachment.
5. Once surfaces are cleaned in one direction, clean a second time at right angles to the first cleaning.
6. Use crevice brush or other tools to clean irregularly shaped surfaces.

W-9

Setting up Work Areas

Note: Polyethylene work area protection is not to be used in place of other engineering controls and good work practices. Work practices such as wetting ACM, careful handling, local collection by HEPA vacuum and local exhaust ventilation should be the primary means of fiber control during O&M work. Polyethylene protection, glovebags, and mini-enclosures are intended as a secondary means of protection during the work. State or local codes might require that fire retardant polyethylene be used for asbestos related work.

The NIBS *Asbestos Abatement and Management in Buildings: Model Guide Specifications* Section 01527 "Regulated Areas" provides information on the preparation of "a regulated area" for small scale, short duration work. Review of this additional information is encouraged.

Polyethylene Drop Cloth Preparing a work area with a drop cloth requires that a single layer of polyethylene be spread on the floor of the work area and taped or weighted in place. Do not use more than one layer if ladders (or similar equipment) will be used, unless a hard surface, such as plywood is laid over the drop cloth. If floor is a soft material, such as carpet, use caution to prevent tearing of polyethylene under equipment. The drop cloth should cover an area large enough to catch falling debris. If work is to be performed at an elevated level, the drop cloth should be placed on the work platform, or extended at ground level beyond the immediate work location to catch any debris that might be generated. Note that the use of a drop cloth introduces potential slip hazards in the work area. Non-slip foot coverings are recommended where drop cloths are used.

Disposal of contaminated water

Contaminated water from O&M activities should be disposed of in accordance with all applicable federal, state and local regulations. Filtering might be required. If filtering is required, water should typically be filtered through a maximum 5 micron (5 μm) water filter before discharging water into a sanitary sewer system, if permitted. If a filter unit is not available at the work location, contaminated water can be put into leaktight drums and transported to a location with filtering equipment. If a portable shower unit with filtering equipment is available, contaminated water can be emptied into the shower and filtered through the shower filter system. The NIBS *Asbestos Abatement and Management in Buildings: Model Guide Specifications* Section 01563 "Decontamination Units" includes a specification for filtering equipment.

Figure 4: Level 1 Worker Checklist Operations and Maintenance Work Practices

Pre-Work Activities

- ☐ Obtain and review copies from Supervisor or Asbestos Program Manager of:
  - ☐ Completed Maintenance Work Authorization Form
  - ☐ Work practice(s) to be used including personal protective equipment options
  - ☐ Work Notification(s) (as applicable)
  - ☐ Schedule for work
- ☐ Review work practices and any other general procedures used in work practice.
- ☐ Inspect work area for visible dust or debris. If present, stop work and notify APM.
- ☐ Obtain recommended tools, equipment and materials as described in Maintenance Work Authorization Form.
- ☐ Move tools, equipment and materials to work area.
- ☐ Shut off and lock out any HVAC or electrical systems to be worked on.
- ☐ If required, on Maintenance Work Authorization Form, put on respirators and perform fit checks.

Work Practices

- ☐ Perform work per steps in work practice(s).

Clean-Up and Tear-Down

- ☐ Remove lockout tags (if used) & restart any HVAC/electrical system(s) that were shut off.
- ☐ Return tools, equipment and remaining materials to storage area.
- ☐ Notify Asbestos Program Manager or supervisor that work is completed & return documents to APM.

Figure 5: Level 2 Worker Checklist Operations and Maintenance Work Practices

Pre-Work Activities	☐	Obtain and review copies from Supervisor or Asbestos Program Manager of: ☐ Completed Maintenance Work Authorization Form ☐ Work practice(s) to be used including personal protective equipment options ☐ Work Notification(s) (as applicable) ☐ Schedule for work
	☐	Review work practices and referenced general procedures used in work practice(s).
	☐	Obtain recommended tools, equipment and materials.
	☐	Obtain required respirators as listed on Maintenance Work Authorization Form.
	☐	Move tools, equipment and materials to work area.
	☐	Shut off and lock out HVAC and electrical systems serving work area.
	☐	Vacate and secure work area, such as by locking doors and/or setting up temporary barriers.
	☐	Put on respirators and perform fit checks.
	☐	Put on protective clothing.
	☐	Air monitoring personnel begins air monitoring work (if required).
	☐	Preclean work area if visible dust or debris is present.
Work Area	☐	Set up work area as required by work practice item 3.
Work Practices	☐	Perform work per steps in work practice(s).
Clean-Up and Tear-Down	☐	Package and label asbestos waste for disposal.
	☐	Apply lockdown encapsulant, where required, using garden sprayer, to surfaces where ACM was removed or disturbed.
	☐	Perform ceiling panel replacement work or ceiling repair work if needed.
	☐	Clean tools, equipment and work area using wet wiping and HEPA vacuuming as appropriate and return tools and equipment to outside work area.
	☐	Decontaminate packaged waste & move waste to outside work area.
	☐	Workers decontaminate and remove protective clothing and respirators. If contaminated, dispose of protective clothing as ACM.
	☐	Complete visual inspection. Complete air monitoring work.
	☐	If feasible, get APM or designee to complete Evaluation of Work Form.
	☐	Transport waste to designated asbestos waste storage area.
	☐	Remove drop cloth.
	☐	Return decontaminated tools, equipment and remaining materials to storage area.
	☐	Remove lockout tags and restart HVAC/electrical system(s).☐Restore normal accessibility to work area.
	☐	Notify Asbestos Program Manager or Supervisor that work is completed & return documents to APM.

Job Request Form for Maintenance Work

Name: _____ Date: _____

Telephone No. _____ Job Request No. _____

Requested starting date: _____ Anticipated finish date: _____

Address, building, and room number(s) (or description of area) where work is to be performed:

_____

_____

_____

_____

Description of work:

_____

_____

_____

_____

_____

Description of any asbestos-containing material that might be affected. if known (include location and type):

_____

_____

_____

_____

_____

Name and telephone number of requestor:

_____

Name and telephone number of supervisor:

_____

Submit this application to:

_____
(The Asbestos Program Manager)

NOTE: An application must be submitted for all maintenance work whether or not asbestos-containing material might be affected. An authorization must then be received before any work can proceed.

_____ Granted (Job Request No. _____)
_____ With conditions*
_____ Denied

*Conditions: _____

_____

Maintenance Work Authorization Form

No. _____

AUTHORIZATION

Authorization is given to proceed with the following maintenance work:

_____

_____

_____

_____

_____

_____

_____

PRESENCE OF ASBESTOS-CONTAINING MATERIALS

_____ Asbestos-containing materials are not present in the vicinity of the maintenance work.

_____ ACM is present. but its disturbance is not anticipated: however, if conditions change, the Asbestos Program Manager will re-evaluate the work request prior to proceeding.

_____ ACM is present. and may be disturbed.

Work Practice if Asbestos-Containing Materials Are Present

The following work practices shall be employed to avoid or minimize disturbing asbestos:

_____

_____

_____

_____

Personal Protection if Asbestos-Containing Materials Are Present

The following equipment/clothes shall be used/worn during the work to protect workers:

_____

_____

_____

_____

_____

(manuals on personal protection can be referenced)

Special Practices and/or Equipment Required:

_____

_____

_____

Signed:_____ Date:_____

(Asbestos Program Manager)

Evaluation of Work Affecting Asbestos-Containing Materials

This evaluation covers the following maintenance work:

Location of work (address, building, room number(s), or general description):

_____

_____

_____

_____

Date(s) of work: _____

Description of work: _____

Work approval form number: _____

Evaluation of work practices employed to minimize disturbance of asbestos:

_____

_____

_____

_____

_____

Evaluation of work practices employed to contain released fibers and to clean up the work area:

_____

_____

_____

_____

Evaluation of equipment and procedures used to protect workers:

_____

_____

_____

_____

Personal air monitoring results: (in-house worker or contract?)

Worker name _____ Results: _____

Worker name _____ Results: _____

Handling or storage of ACM waste: _____

Signed: _____ Date: _____
(Asbestos Program Manager)

Waste Tracking Form

Part 1 - To be completed by workers:

Maintenance World Authorization No._____

Work Location: Building: _____

Room # or Area: _____

Type of ACM Removed: _____

Quantity of Waste generated: _____ Bags

Other containers:_____

_____

Waste transported to: _____

Transported by: _____

Tracking Form given to: _____

Part 2 - To be completed by Asbestos Program Manager

Waste Properly Packaged & Labeled: Yes _____ No _____

EXCEPTIONS: _____

_____

Waste Storage Location: _____

Waste Disposal Location: _____

Waste Shipment Records Received: _____

Date: _____

SIGNED: _____
ASBESTOS PROGRAM MANAGER

DATE: _____

O & M Work Practices

M1 . Level 1

Replacement of resilient asbestos floor tiles

Examples Level 1: *(RFCM Procedures see page 144)*

A. Replacement of several floor tiles that are loose or can be removed with minimal or no breakage, and tile and/or mastic does not become friable.

B. Remove well-adhered tile and/or mastic that is not likely to become friable.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.

Use Work Practice M31 if HEPA vacuum needs maintenance, or if bag or filter needs to be replaced.

Warning: Do not sand flooring or backing.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***

   Weighted scraper with long handle
   Wall scraper 2-3" (50-75 mm) wide stiff blade w/short handle
   Commercial-type hand-held hot air blower or radiant heat source
   Safety glasses
   Weighted scraper with long handle
   Wet/dry type HEPA vacuum with hose and attachments with metal floor tool
   Garden sprayer with amended water
   Hammer
   Crushed dry ice (for procedure 5B) - approximately 1 lb (0.5 kg) per sq.ft. (0.1 m^2)
3. Place tools, equipment and materials needed in work area.
4. RFCM removal procedure is described in step 5A. An alternative non-RFCM procedure using dry ice is described in step 5B.
5. Clean the affected floor area with a wet/dry type HEPA vacuum and a metal floor attachment (no brush). Do not sweep.
6. **A.** Start the removal by carefully wedging the scraper in the seam of two adjoining tiles and gradually lifting the edge of the tile up and away from the floor. Try not to break pieces of the tile but continue to work the balance of the tile up by working the scraper beneath the tile and exerting both a forward pressure and a twisting action on the blade to promote release of the tile from the adhesive and the floor. Some tiles will release quite easily while others require varying degrees of force. When the adhesive is spread heavily or the tile is bonded tightly, it may easier to force the scraper through the tightly adhered areas by striking the scraper

handle with a hammer using blows of moderate force while maintaining the scraper at 25 to 30 degree angle to the floor. If you encounter areas where even the above methods will not remove the tile, the removal procedure can be simplified by thoroughly heating the tiles with a hot-air blower or a radiant heat source until the heat penetrates through the tile and softens the adhesive. *Caution: Heating resilient tile or mastic might produce toxic vapors and a respirator with organic vapor cartridges might be needed.*

B. Dry ice tile removal procedures:

Caution: The use of dry ice produces carbon dioxide that can result in an oxygen deficiency in the work area. Dry ice can also cause frostbite to workers and damage building materials.

Spread crushed dry ice over tiles to be removed. Let dry ice freeze mastic and release tile. Use short-handled scraper to pry up tiles.

7. When the tile is removed, place it, without breaking it, in disposal bags or containers which will be used for disposal. Removed tiles can be placed in empty tile cartons first and then placed in the disposal bags. To prevent tearing of the bag, place a maximum of one full carton of removed tile in a bag.
8. If new resilient floor tile is to be installed over a concrete subfloor using an asphaltic adhesive, the residual asphaltic "cutback" adhesive (mastic) must be left so that no ridges or puddles are evident and what remains is a thin, smooth film. This can be accomplished by wet-scraping the residual adhesive as follows:
   A. Start by adequately wetting the area where tile(s) were removed using amended water. Wet-scrape with a stiff-bladed wall or floor scraper, removing ridges and any loose adhesive.
   B. Place loosened adhesive residues into disposal bags or other containers.
   C. Wet vacuum standing water with the HEPA vacuum cleaner.
   D. Continue steps A through C until what remains of the residual asphaltic "cutback" adhesive is a thin, smooth film.
9. Clean the affected floor area with the HEPA vacuum cleaner using the metal floor tool to remove debris before applying new asphaltic adhesive or installing new resilient floor tile.
10. Perform required clean-up and tear-down steps on Level 1 checklist to complete work.

M2 . Level 1

Replacement of vinyl sheet flooring with ACM backing

Examples Level 1: *(RFCM Procedures see page 144)*

A. Replacement of loose or perimeter-adhered vinyl sheet flooring with ACM backing.

B. Replacement of adhered vinyl sheet flooring with ACM backing that can be removed using non-aggressive, primarily manual methods. Some separation of backing and wear layer will occur.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.

Warning: Do not sand flooring or backing.
Use Work Practice M31 if HEPA vacuum needs maintenance, or if bag or filter needs to be replaced.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   Garden sprayer with amended water
   Stiff bladed wall or floor scraper
   Hook knife
   Wet/dry type HEPA vacuum with hose and attachments with metal floor tool
3. Place tools, equipment and materials needed in work area.
4. Removal Procedure:
   A. Remove any binding strips or other restrictive moldings from affected area.
   B. Clean the affected floor area with the HEPA vacuum cleaner using the metal floor tool.
   C. Make a series of parallel slices 4" to 8" (100-200 mm) apart through the flooring to be removed.
   D. Removal: Pry up the corner of a strip of flooring. As the strip is being removed, adequately wet (using amended water) the removal point to minimize any airborne dust particles. When done properly, the floor and the back of the strip should be adequately wet. Do only one three-strip area at a time. Stand on the remaining floor covering or clean floor ***(do not stand on the felt).*** The sliced strip should be rolled around a core which will control the stripping angle to create a uniform tension. Tie or tape the removed material securely and place in disposal bags or containers for disposal.

E. Remove and dispose of each strip in the above manner. Avoid walking on the exposed felt as much as possible.

F. Occasionally, parts of the flooring will stick to the subfloor. This can often be eliminated by peeling in the opposite direction. The stiff-bladed scraper may aid in the removal or peeling of the flooring. If any residual felt backing remains on the subfloor, remove it using wet scraping methods set forth in step 6G.

G. Wet-scraping residual felt:

1. Adequately wet the residual felt with amended water. Wait for a few minutes to allow the amended water to soak into the felt.
2. Use the stiff-bladed scraper to scrape up the wet felt.
3. Rewet the felt if the amended water has not completely penetrated, if drying occurs, or if dry felt is exposed during scraping. Pick up the scrapings as they are removed from the floor and place in disposal bags or containers. Wet-scrape felt from affected floor area.
4. When this floor area has been cleaned free of felt, vacuum up any dirt using the HEPA vacuum cleaner with the metal floor tool. Position the vacuum cleaner so that the discharge air does not blow on the area being cleaned.
5. If HEPA vacuum filter or bag needs to be changed, use work practice M31.
6. Allow substrate to dry before installing new flooring.

5. Perform required clean up and tear-down steps on Level 1 checklist to complete work.

M3 . Level 1

Penetrate resilient asbestos flooring and subfloor

Example Level 1: **A.** Remove small amount of resilient asbestos floor covering to drill hole(s) in subfloor to attach object to floor or install a pipe or conduit.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.
Use Work Practice M31 if HEPA vacuum needs maintenance, or if bag or filter needs to be replaced.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(See General Procedure W1 for standard tools, equipment and materials list).***
   Scraper
   Drill
   Hook Knife
3. Place tools, equipment and materials needed in work area.
4. Cut out a piece of resilient asbestos flooring larger than the hole to be drilled using utility or hook knife. Use scraper to pry up a piece of flooring. Place flooring piece into disposal bag, adequately wet mastic or residual felt using amended water and scrape up using M1 Level 1 step 7 procedures for tile and M2 Level 1 step 4F for vinyl sheet flooring.
5. Drill hole into subfloor as needed.
6. Clean up dust and debris using HEPA vacuum.
7. Perform maintenance work required and clean-up and tear-down steps on Level 1 checklist to complete work.

M3 . Level 2

Penetrate resilient asbestos flooring and subfloor

Example Level 2: **A.** Drill or cut a few hole(s) in resilient asbestos flooring to install pipe or conduit.

Notes

*This work practice must be used in conjunction with General Procedures **W1, W9** and a **Level 2 Worker Checklist.** The worker checklist includes tasks that must be performed before these work practices are begun.*

*Coordinate work with proper O & M work practice for accessing type of ceiling present in work area if debris from work may fall on ceiling below. See **work practices S1, M11, M13 or M24.***

Work Practice

1. Perform Pre-work activities on Level 2 checklist.
2. Additional tools, equipment and materials: ***(See General Procedure W1 for standard tools, equipment and materials list).***
   Drill or hole saw with HEPA vacuum attachment
   Small stiff-bladed scraper
3. Prepare work area with drop cloth covering work area except where holes are being drilled. ***See General Procedure W9.*** If hole being drilled or cut is to penetrate through floor, an enclosure will be needed on the underside to catch any dust or debris that may fall to floor below.
4. Place tools, equipment and materials needed onto drop cloth.
5. Adequately wet area where penetration must be made using amended water and, if desired, cut out a piece of flooring larger than the hole to be made using utility knife and scraper.
6. Using drill or hole saw with wetting or attached HEPA vacuum, perform drilling or cutting operation. Wet all dust or debris generated using amended water.
7. Clean up dust and debris using HEPA vacuum and/or wet wiping and place disposable towels into disposal bags.
8. If hole was drilled through floor, wet any debris or dust in enclosure and underside. Package debris or dust as ACM waste.
9. Perform maintenance work required and clean-up and tear-down steps on Level 2 checklist to complete work.

M4 . Level 1

Install new resilient flooring or carpet over resilient asbestos flooring

Example Level 1: **A.** New carpet being installed over well-adhered resilient asbestos tile or vinyl sheet flooring with ACM backing in good condition.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.

Review manufacturer's recommendations concerning installation of new flooring over existing before proceeding with this work. Coordinate this work with floor stripping work practice M6 as required in step 5.
Use Work Practice M31 if HEPA vacuum needs maintenance, or if bag or filter needs to be replaced.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   Scraper 2-3" (50-75 mm) wide stiff blade
3. Place tools, equipment and materials needed into work area.
4. HEPA vacuum area where flooring will be installed.
5. Strip wax/finish from existing floor using O&M work practice M6.
6. Level off any minor high spots on floor using scraper. Do not sand or grind flooring.
7. Fill any low areas using manufacturers recommended underlayment or Leveling compound.
8. Install new flooring or carpet as recommended by manufacturer.
9. Perform clean-up and tear-down steps on Level 1 checklist to complete work.

M5 . Level 1

Install Partition over resilient asbestos flooring

Example Level 1: A. Install partition over resilient asbestos flooring that is well-adhered and in good condition.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.
Use Work Practice M31 if HEPA vacuum needs maintenance, or if bag or filter needs to be replaced.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   Anchoring devices and equipment
   Non-asbestos adhesive
3. Place tools, equipment and materials needed in work area.
4. Install base plate of wall on full bed of adhesive and attach to floor using appropriate anchoring devices.
5. HEPA vacuum any chips or dust generated during fastening operation.
6. Complete installation of wall.
7. Perform cleanup and tear down steps on Level 1 checklist to complete work.

M6 . Level 1

Wet strip floor wax from resilient asbestos flooring

Example Level 1: **A.** Strip floor wax or finish coat from resilient asbestos flooring that is well-adhered and in good condition.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.

Stripping pads should be kept wet during use and rinsed thoroughly immediately after use and prior to storage. Dispose of pads, if contaminated, as ACM waste in labeled disposal bags.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   - "Caution - Wet Floor" signs
   - Floor stripping machine
   - Stripping Pads (least abrasive pad possible)
   - Buckets with water for rinsing
   - Mops (for stripping, rinsing and polishing)
   - Chemical stripper - recommended amount for area to be stripped
   - Floor wax or finish
   - Walk-off mats
3. Place tools, equipment and materials needed in work area. Place walk-off mats where required to prevent tracking of stripping solution to other areas. Position "Caution - Wet Floor" signs.
4. After proper mixing of stripping chemical, adequately wet floor by mop applying liberal amounts of the solution. Allow chemical to soak for amount of time recommended by manufacturer. If areas become dry, reapply solution to keep floor adequately wet.
5. After wax or finish has softened, strip flooring using least abrasive pad and low speed setting (175-190 RPM maximum). Keep floor adequately wet during machine operation. Do not overstrip. Stop stripping when the old wax or finish is removed. Work small areas at a time.
6. Remove dirty stripping solution with wet vacuum or "strip" mop.
7. With "rinse" mop, apply liberal amount of clean water to area stripped and remove water with wet vacuum or mop. Repeat rinse procedures.
8. If some spots of wax or finish remain, restrip those areas.
9. If new flooring will be installed over the stripped floor, do not apply wax or finish. When applying new wax or finish, do so according to manufacturer's recommendations.
10. Perform clean-up and tear-down steps on Level 1 checklist to complete work.

M7 . Level 1

Dry or spray buffing resilient asbestos flooring

Example Level 1: *(RFCM Procedures see page 144)*

A. Dry or spray buff the polish on resilient asbestos flooring to remove minor surface imperfections and restore gloss.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.

Dispose of pads, if contaminated, as ACM waste in labeled disposal bags.

Work Practice

1. Perform applicable pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   - "Caution - Wet Floor" signs
   - Floor buffing machine
   - Buffing Pads (least abrasive - tan, red, or equivalent)
   - Buckets with mop wringer
   - Mops (for damp or spot mopping)
   - Chemical cleaner
   - Hand-held scraper
   - Spray buffing compound, appropriately diluted, compatible polish and restorer chemical
3. Place tools, equipment and materials needed in work area. Position "Caution-Wet Floor" signs.
4. Pick up any large loose debris and place into disposal bags. Using scraper and water, remove all foreign matter from the finished surface (gum, tar, stickers, etc.).
5. Spot or damp mop to remove stains and spills. Mix chemical cleaner or restorer with water and apply according to manufacturers recommendations. Spot or damp mop to remove stains and spills. If dry buffing will be performed, apply restorer chemical as required.
6. Allow floor to dry thoroughly.
7. A. To spray-buff, spray small area with spray-buff solution and buff using manufacturer's recommended pad or brush at recommended RPM. Repeat procedure until entire area is spray-buffed.
   B. To dry buff, buff or dry burnish with manufacturer's recommended pad or brush at recommended RPM.
8. Perform applicable steps on Level 1 checklist to complete work.

M8 . Level 1

Cleaning resilient asbestos flooring

Example Level 1: **A.** Clean or scrub resilient asbestos flooring with adequate coats of floor polish on flooring before buffing or application of additional polish.

Notes *This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.*

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   - "Caution - Wet Floor" signs
   - Floor scrubbing machine
   - Pads (least abrasive)
   - Buckets with mop wringer
   - Scraper 2-3" (50-75 mm) wide stiff blade
   - Mops (for scrubbing, rinsing)
   - Measuring device for mixing chemical cleaner
   - Walk-off mats
   - Chemical cleaner
3. Place tools, equipment and materials needed in work area. Place walk-off mats to prevent tracking of scrubbing solution to other areas. Position "Caution - Wet Floor" signs.
4. Install polyethylene sheet on adjoining floors for protection from any spilled cleaning solution.
5. Mix scrubbing chemical with water as recommended by manufacturer and apply liberal amount (do not flood) using mop. Allow to soak for amount of time recommended by manufacturer. Keep floor adequately wet by reapplying cleaning solution if drying occurs. Work small areas at a time.
6. Using floor scrubbing machine, manufacturer's recommended pads and operating speed, clean floor to remove embedded dirt and surface marks.
7. Remove spent scrubbing solution with wet vacuum or mop.
8. Rinse area using clean mop and clean rinse water. Remove water with wet vacuum or mop. Damp mop area to clean up any remaining water or streaks.
9. Perform applicable steps on Level 1 checklist to complete work.

M9 . Level 1

Remove carpet over resilient asbestos flooring

Example Level 1: A. Remove carpet that is non-adhered or weakly adhered to resilient asbestos flooring.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.

Review manufacturer's recommendation concerning installation of new carpet over old flooring and/or adhesive before proceeding with this work. If asbestos-containing adhesive must be removed, refer to wet-scraping procedures in Work Practice M1.
Use Work Practice M31 if HEPA vacuum needs maintenance, or if bag or filter needs to be replaced.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   Metal straightedge for use when cutting carpet
   Scraper 2-3" (50-75 mm) wide stiff blade
3. Place tools, equipment and materials needed in work area.
4. Find a seam or corner where carpet removal can begin. If no seams or corners exist, make a cut around the piece to be removed. Cut carpet using utility knife with a new blade.
5. Pry up corner or seam of carpet using scraper. Pull back a section large enough (approximately one square foot [0.1 m^2]) to hang onto while removing carpet. HEPA vacuum exposed flooring and back of carpet.
6. Pull carpeting back slowly and HEPA vacuum exposed flooring & back of carpet. Remove carpet in pieces no larger than 200 square feet (18.6 m^2).
7. If carpet and adhesive are non-ACM, roll up carpet and dispose of as non-ACM waste. If portions of asbestos-containing flooring remain attached to carpet backing, dispose of carpet as ACM or in accordance with applicable regulations.
8. HEPA vacuum surface of flooring after carpet is removed. If residual asbestos-containing adhesive or residual felt backing needs to be removed, follow wet-scraping procedures in work practice M1 or M2, respectively. Allow substrate to dry before installing new flooring.
9. Perform clean-up and tear-down steps on Level 1 checklist to complete work.

M29 ▪ Level 1

Clean up debris from minor fiber release

Example Level 1: **A.** Clean up small amount of ACM debris that will stick to a small piece of duct tape.

Notes

This work practice must be used in conjunction with General Procedure W1 and a Level 1 Worker Checklist. The worker checklist includes tasks that must be performed before these work practices are begun.

Coordinate work with proper O & M work practice to repair cause of fiber release if repair is necessary.

Work Practice

1. Perform Pre-work activities on Level 1 checklist.
2. Additional tools, equipment and materials: ***(see General Procedure W1 for standard tools, equipment and materials list).***
   None
3. Cover debris with duct tape and press to adhere debris to tape. Repeat with another piece of tape if needed. Dispose of tape as ACM or in accordance with applicable regulations.
4. Perform applicable steps on Level 1 checklist to complete work.