DEPARTMENT OF HOMELAND SECURITY
UNITED STATES COAST GUARD
ENGINEERING SERVICES DIVISION

SPECIFICATIONS
FOR
CANFIELD HALL, BLDG 229
REPAIR HVAC AND RECONFIGURE INTEL SCIF
PROJECT NUMBER 9965171

U.S. COAST GUARD TRAINING CENTER YORKTOWN
YORKTOWN, VA 23690

June 11, 2020

COMMANDING OFFICER
UNITED STATES COAST GUARD
CIVIL ENGINEERING UNIT, RM 2179
1240 EAST NINTH STREET
CLEVELAND, OHIO 44199-2060

AUTHOR: Gary R. Marsh

RTA
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PART 1   GENERAL

1.1   WORK COVERED BY CONTRACT DOCUMENTS

1.1.1   Project Description

Conduct HVAC maintenance & repair to improve system effectiveness. Reconfigure Intel SCIF to accommodate additional permanent staff and replace carpets at Canfield Hall, Building 229 at US Coast Guard Training Center Yorktown, Yorktown, Virginia.

Base Work: Includes but not limited to:

1. Replace six fan coil units and selected condensate pumps with new. Provide automatic balance valves and strainers inside mechanical rooms or field install above ceiling for hot water (HW) and chilled water (CW) systems for the fan coils. Reconnect FCU-6 chilled water supply (CWS) down stream of second chiller.

2. Replace selected mini-split units installed on second floor Intel spaces with new with factory accessory that allows BAS control of the units to coordinate supplemental cooling and operate in heating mode to provide re-heat in lieu of existing fin tubes. Replace condensate pumps and provide alarm to BAS on high condensate level.

3. Modify AHU-3 system Building Automation System (BAS) controls as indicated, replace selected VAV box, install automatic balance dampers at indicated locations, relocate VAV to new location as indicated, replace Room 205 lighting and diffusers and modify ductwork as indicated, modify ductwork to Room 211 as indicated, add exhaust fan for cooling fan to Room 206, update sequence to control mini-splits. Rebalance.

4. Add VFD drives and pressure control to existing hot water pumps. Replace and move AHU balance valves with automatic balance valves at indicated locations. Replace strainer at AHU-1 as indicated. Remove selected valves. Remove selected fin tubes and relocate selected fin tube control valves to the ceiling space. Replace selected valves and thermometers. Rebalance.

5. Add VFD drive and pressure control to existing chilled water pump. Correct pressure gage piping on three pumps, relocate pot feeder and provide glycol feeder as indicated. Replace and move AHU balance valves with automatic balance valves. Remove selected valves. Replace selected control valve type and sizes as indicated. Replace selected valves, pressure gauge and thermometers as indicated. Rebalance.


7. Paint walls, replace carpet and ceiling tiles where indicated.
8. Install a door and frame where indicated.

9. Replace all disconnect switch and branch circuit wiring for the outdoor/indoor mini-split units.

Work Item 1: Modify ductwork on AHU-3 return to provide new return fan RF-3, with VFD to control fan speed under indicated conditions.

Work Item 2: Provide 2 ton mini-split air conditioner to Room 124 with BAS enable of the mini-split and the existing fan based on building status and outside air conditions. Provide power branch circuit to new mini-split.

Unit Work Item 1: Move DDC control valve from fin tube housing to ceiling space. Provide new valve body as required and reuse existing valve control actuator. Include new isolation valves above the ceiling.

Unit Work Item 2: Refurbish existing fin tube with new isolation, balance valves and new thermostatic radiator valve (TRV). Clean fins.

Unit Work Item 3: Replace existing fin tube and valves with panel radiator complete with integral TRV, new balance valve and isolation valves.

1.1.2 Location

The work shall be located at the Coast Guard Training Center, Yorktown, Virginia. The exact location is shown on the drawings.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit the following items to the Contracting Officer:

Utility Outage Requests
Welding Permits

1.3 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Sheet</th>
<th>Drawing Title</th>
</tr>
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<tbody>
<tr>
<td><strong>GENERAL</strong></td>
<td></td>
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</tr>
<tr>
<td>G-001</td>
<td>1</td>
<td>TITLE SHEET</td>
</tr>
<tr>
<td>G-002</td>
<td>2</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td><strong>ARCHITECTURAL</strong></td>
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</tr>
<tr>
<td>A-101</td>
<td>3</td>
<td>FLOOR PLANS</td>
</tr>
<tr>
<td>A-301</td>
<td>4</td>
<td>SECTIONS</td>
</tr>
<tr>
<td><strong>MECHANICAL</strong></td>
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<tr>
<td>M-101</td>
<td>5</td>
<td>HVAC 1ST FLOOR</td>
</tr>
<tr>
<td>M-102</td>
<td>6</td>
<td>HVAC 2ND FLOOR</td>
</tr>
</tbody>
</table>
The drawings will be made available in a format determined by the solicitation method.

Contractor shall immediately check furnished drawings and notify the Contracting Officer and COR of any discrepancies.

1.4 WORK RESCHEDULING

Contractor shall allow for a maximum of 5 calendar days where construction activity is prohibited. COR will provide 48 hour notification each time the restrictions are invoked.

Normal duty hours for work shall be from 7:00 a.m. to 5:00 p.m., Monday through Friday. Requests for additional work shall require written approval from the COR 7 days in advance of the proposed work period, but at no additional cost to the Government.

1.5 PROJECT ENVIRONMENTAL GOALS

The overall goal for design, construction, and operation is to produce a building that meets the functional program needs and incorporates the principles of sustainability. Specifically:

a. Preserve and restore the site ecosystem and biodiversity; avoid site degradation and erosion. Minimize offsite environmental impact.

b. Use the minimum amount of energy, water, and materials feasible to meet the design intent. Select energy and water efficient equipment and strategies.

c. Use environmentally preferable products and decrease toxicity level of materials used.

d. Use renewable energy and material resources.
e. Optimize operational performance (through commissioning efforts) in order to ensure energy efficient equipment operates as intended. Consider the durability, maintainability, and flexibility of building systems.

f. Manage construction site and storage of materials to ensure no negative impact on the indoor environmental quality of the building.

g. Reduce construction waste through reuse, recycling, and supplier take-back.

1.6 OCCUPANCY OF PREMISES

Building(s) will be occupied during performance of work under this Contract.

Before work is started, the Contractor shall arrange with the Contracting Officer Representative (COR) a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

1.7 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.8 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

For any month in which actual adverse weather days exceed the number of anticipated adverse weather days listed below, the Contracting Officer will consider a request for a time extension. Using its approved schedule, the Contractor shall demonstrate the impact on project progress resulting from the severe weather. The progress schedule shall incorporate the anticipated adverse weather days. Time extensions will be granted only for the number of adverse weather days exceeding the anticipated number. Also, time extensions will be granted at no additional cost to the government.

MONTHLY ANTICIPATED ADVERSE WEATHER CALENDAR DAYS

<table>
<thead>
<tr>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
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<td>12</td>
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1.9 CONTRACTOR'S DAILY CONSTRUCTION REPORT

Daily reports shall be completed by the Contractor's superintendent each day and submitted to the COR by 0900 of the following day. Forms are provided by the Contracting Officer. All applicable parts of the form shall be completed each day. If multiple daily shifts are used, submit a report for each shift. Daily reports shall be submitted for each day from the time the contractor mobilizes until the contract is complete and accepted by the
Government. For successive days on which no work was performed, one report may be submitted covering all of the days.

1.10 ON-SITE PERMITS

1.10.1 Utility Outage Requests

Notify the COR at least 48 hours prior to starting excavation work. Contractor is responsible for marking and verifying all utilities not marked.

The Contractor shall verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed. But indicated in locations to be transversed by piping, ducts, and other work to be installed.

Work shall be scheduled to hold outages to a minimum.

Contractor shall not be entitled to additional payment for utility outages and connections required to be performed outside the regular work hours.

Requests for utility outages and connections shall be made in writing to the COR at least 14 calendar days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of work involved.

1.10.2 Borrow, Excavation, Welding, and Burning Permits

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>SUBMISSION DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding Permits</td>
<td>14 calendar days prior to work</td>
</tr>
</tbody>
</table>

Permits shall be posted at a conspicuous location in the construction area.

Burning of trash or rubbish is not permitted on project site.

1.11 LOCATION OF UNDERGROUND FACILITIES

Obtain digging permits prior to start of excavation by contacting the COR 15 calendar days in advance. Contractor shall use a commercial utility locator service prior to excavation. Scan the construction site with electromagnetic or sonic equipment, and mark the surface of the ground or paved surface where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground or encased obstruction not indicated to be specified or removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.12 SALVAGE MATERIAL AND EQUIPMENT

Items designated by the Contracting Officer's Rep to be salvaged shall remain the property of the Government. Salvaged material shall include:

a. Control devices removed from existing systems such as damper actuators, valve actuators and temperature sensors.

b. As noted on drawings.
PART 2  PRODUCTS
   Not used.

PART 3  EXECUTION
   Not used.

   -- End of Section --
PART 1   GENERAL

Detailed security requirements and outage planning which may impact contractor's schedule are shown on the drawings.

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Access List
Phasing Plan

1.2 SPECIAL SCHEDULING REQUIREMENTS

a. Preplanning, procurement of equipment, scheduled outages and phasing of construction is required to allow continued operation of the occupied portions of the building throughout construction and to minimize downtime. Contractor is required to submit a Phasing Plan as indicated.

b. Have materials, equipment, and personnel required to perform the work at the site prior to the commencement of the work. Specific items of work to which this requirement applies include:

c. The building will remain in operation during the entire construction period. The Contractor shall conduct his operations so as to cause the least possible interference with normal operations of the Activity.

d. Permission to interrupt any Activity roads, and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.
1.3.1.1 TRACEN Short Term Contractor's Access List

The contractor shall submit the required TRACEN Short Term Contractor's Access List for USCG Training Center Yorktown with all personnel who will be coming on site to the Contracting Officer and COR before work starts on site. This access list shall be completely filled out and submitted to the COR, who will forward it to the Base Security Officer for approval. No personnel will be allowed on base until the required information is submitted and approved by the Base Security Officer. The Contractor shall anticipate that it could take up to 5 working days to receive approval of the access list. It is the Contractor's responsibility to submit this list in a timely manner and with all required information provided. Any delays to the project due to the access list not being approved (late submission of list or missing/incorrect information) are the contractor's responsibility and not the government's. Persons not included on the access list will not be allowed on base. All contractor personnel, subcontractor personnel and visitors shall be included on the list. List shall be updated and resubmitted for new contractor personnel, subcontractor personnel and contractor visitors before they are allowed access to the base.

a. Persons bringing vehicles on base will need to have with them a valid driver's license, registration, and proof of insurance in addition to being on the access list. Persons coming on base will need to have a valid picture ID card in addition to being on the access list. If these items cannot be presented at the gate, the vehicle(s) and/or person(s) will not be allowed on base.

b. Registration, proof of insurance and a current state inspection sticker will need to be presented in order to obtain access.

c. If the contractor desires, a RAPIDGate pass may be used instead of obtaining daily passes by calling 1-877-RAPIDGate (1-877-727-4342). More information about the enrollment process can be found in the attachment titled "RAPIDGate Program Enrollment Information". Once enrolled and eligible to receive a RAPIDGate credential, employees will be able to apply at the kiosk located at the USCG TRACEN Yorktown Security Building and pick up the credential at the same location once approved. Companies already enrolled in the RAPIDGate Program at another installation such as Norfolk Naval Base, may request access for their employees at this installation by calling 1-877RAPIDGate (1-877-727-4342). Once the company is approved by TRACEN Yorktown, its employees who already hold RAPIDGate Credentials will be able to use them at this installation.

d. If you have any questions regarding USCG TRACEN Yorktown access control, please contact Base Security Officer, at 757-856-2150.

1.3.1.2 Personnel Entry Approval

Failure to obtain entry approval will not affect the contract price or time of completion.

1.3.1.3 No Smoking Policy

Smoking is prohibited within and outside of all buildings except in designated smoking areas. This applies to existing buildings, buildings under construction and buildings under renovation. Discarding tobacco
materials other than into designated tobacco receptacles is considered littering and is subject to fines. The COR will identify designated smoking areas.

1.3.2 Working Hours

Regular working hours are 7 a.m. to 5:00 p.m., Monday through Friday, excluding Government holidays.

1.3.3 Work Outside Regular Hours

Work outside regular working hours requires COR approval at no additional cost to the Government. Make application 15 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the COR.

1.3.4 Base Maintenance Contractor

The Base Maintenance Contractor as mentioned herein is a private contractor retained by the Government for base operations support services. Coordinate with the COR for services available from the Base Maintenance Contractor.

1.3.5 Fire Prevention

The Contractor shall comply with the standards of the National Fire Protection Association and 29 CFR 1910.119(k). In addition, the Contractor shall obtain a daily hot work permit from the COR prior to setting any fire, welding, or performing any cutting involving hotwork.

1.3.6 Occupied and Existing Building

The Contractor shall be working in an existing building which is occupied.

The existing building and their contents shall be kept secure at all times. Provide temporary closures as required to maintain security as directed by the COR.

Provide dust covers or protective enclosures to protect existing work that remains and Government material located in the building during the construction period.

Relocate movable furniture away from the Contractor's working area as required to perform the work, protect the furniture, and replace the furniture in its original location upon completion of the work.

1.3.7 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, air conditioning, heating, and fire alarm, shall be considered utility cutovers pursuant to the
paragraph entitled "Work Outside Regular Hours."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)


1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Schedule of prices

1.3 SCHEDULE OF PRICES

1.3.1 Data Required

Within 10 calendar days of notice of award, prepare and deliver to the Contracting Officer a schedule of prices.

a. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices. Submit with the Project Schedule. This schedule shall include but not be limited to costs of materials, equipment, and labor for all major work categories shown on the Project Schedule.

b. The Contractor shall adhere to the following guidelines when developing the schedule of prices

1. Format - The line items in the schedule of prices shall be the same as that of the Project Schedule.

2. Bonds - Bonding costs will only be paid in a lump sum if they are broken out separately and included with the schedule of prices. The Contractor shall provide evidence that he has furnished full payment to the surety.

3. Materials - To request progress payments for materials delivered to the construction or fabrication site, the particular category of work associated with the materials must be broken down into separate material and labor costs.
1.3.2 Schedule Instructions

Payments will not be made until the schedule of prices has been submitted to and approved by the Contracting Officer. Schedule of prices shall be prepared in accordance with the following instructions:

a. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

b. Each item shall be broken down into cost of materials, and the cost of labor to install the materials. The cost of materials shall include taxes. The labor cost shall include taxes and insurance.

c. Use unit prices for items whenever practical.

d. Lump sum items will only be paid for when an item is 100 percent complete. Partial payments will not be made on lump sum items.

e. If payment for materials received but not installed will be requested, the material shall be listed as a separate item on the schedule of prices. In order for requests for payment to be considered, the material shall have an approved submittal, and shall be on site and properly stored or protected. If authorized, the amount paid will be 80 percent of the lesser of the cost listed in the schedule of prices or that shown on the manufacturer's/supplier's invoice submitted for the material.

f. Mobilization costs may be included in the schedule of prices. If they are included, equivalent demobilization costs shall also be included.

g. The schedule of prices shall list O&M Manual and As-Built Drawings at not less than $10,000.

h. The schedule of prices shall list "Equipment Enrollment Form (EEF)" at a value specified under Section 01 80 00 FACILITY PREVENTATIVE MAINTENANCE PROGRAM (FPMP).

1.4 CONTRACT MODIFICATIONS

In conjunction with "FAR Clause 52.243-4, Changes" the price proposal breakdown must include sufficient detail to permit an analysis of profit, and of all costs for material, labor, equipment, subcontracts, overhead, and must cover all work involved in the modification, whether the work was deleted, added or changed. Where actual ownership and operating costs of construction equipment cannot be determined from Contractor accounting records, equipment use rates shall be based upon the applicable provisions of the EP-1110-1-8.

1.5 CONTRACTOR'S INVOICE

Requests for payment will be processed in accordance with the Contract Clause "FAR 52.232-27, Prompt Payment Construction Contracts,". Prior to submitting a request for payment to the Contracting Officer, the Contractor shall submit a preliminary copy for pre-approval as follows:

a. The Contractor's superintendent or project manager (designated company representative) shall provide the COR a copy of the proposed request for payment. The COR will review the proposed request for payment and return a marked up copy of the request to the Contractor, indicating
which items are acceptable for payment and those which are not. The Contractor shall then prepare the request for payment based on this marked up copy and the requirements in this specification section.

b. Submit invoices as stated in the contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --
PART 1   GENERAL

1.1  SUMMARY

Section Includes: Administrative requirements for requests for information.

1.2  DEFINITIONS

a. Request for Information: A document submitted by the Contractor requesting clarification of a portion of the contract documents, hereinafter referred to as RFI (Request for Information).

b. Proper RFIs: A properly prepared request for information shall include a detailed written statement that indicates the specific Drawings or Specification in need of clarification and the nature of the clarification requested.

   (1) RFIs shall be sequentially numbered.
   (2) Drawings shall be identified by drawing number and location on the drawing sheet.
   (3) Specifications shall be identified by Section number, page and paragraph.

c. Improper RFIs: RFIs that are not properly prepared.

   (1) Improperly prepared RFIs will not be processed by the Contracting Officer, but will be returned unprocessed.

d. Frivolous RFIs: RFIs that request information that is clearly shown on the Contract Documents.

   (1) Frivolous RFIs may be returned unprocessed.

1.3  CONTRACTOR'S REQUESTS FOR INFORMATION

a. When the Contractor is unable to determine from the Contract Documents, the material, process or system to be installed, the Contracting Officer shall be requested to make a clarification of the indeterminate item.

   (1) Wherever possible after contract award, such clarification shall be requested at the next site visit by the Contracting Officer's Representative (COR), with the response entered on the daily reports. When clarification at the COR's site visit is not possible either because of the urgency of the need, or the complexity of the item, Contractor shall prepare and submit an RFI to the Contracting Officer.

b. Contractor shall endeavor to minimize the number of RFIs. In the event that the process becomes unwieldy, in the opinion of the Contracting
Officer because of the number and frequency of the RFIs submitted, the Contracting Officer may require the Contractor to abandon the process and submit future requests as either submittals, substitutions or requests for change.

c. RFIs shall be submitted on the form provided by the Contracting Officer. Forms completely filled in, and if prepared by hand, shall be fully legible after photocopying or fax transmission. Each page of the attachments to RFIs shall bear the RFI number in the upper right corner.

d. RFIs shall be originated by the Prime Contractor.

(1) RFIs from subcontractors or material suppliers shall be submitted through, reviewed by, and signed by the Prime Contractor prior to submitting to the Contracting Officer

(2) The Contracting Officer will neither act on nor respond to RFIs received directly from subcontractors or suppliers

e. Contractor shall carefully study the Contract Documents to assure that the requested information is not available therein. RFIs which request information available in the Contract Documents will be deemed either Improper or Frivolous as defined above.

f. In cases where RFIs are issued to request clarification of coordination issues, for example, pipe and duct routing, clearances, specific locations of work shown diagrammatically, and similar items when feasible, Contractor shall fully lay out a suggested solution using drawings or sketches drawn to scale, and submit with the RFI.

g. RFIs shall not be used for the following purposes:

(1) To request approval of submittals.

(2) To request approval of substitutions.

(3) To request changes which entail additional cost or credit.

(4) To request different methods of performing work than those drawn and specified.

h. In the event the Contractor believes that a clarification by the Contracting Officer results in additional cost or time, the Contractor shall not proceed with the work indicated by the RFI until a modification is prepared and approved. RFIs do not automatically justify a cost increase in the work or a change in the project schedule.

(1) Answered RFIs shall not be construed as approval to perform extra work.

i. Contractor shall prepare and maintain a log of RFIs, and at any time requested by the Contracting Officer, Contractor shall furnish copies of the log showing outstanding RFIs. Contractor shall note unanswered RFIs in the log.

j. Contractor shall allow up to 14 days review and response time for RFIs, however, the Contracting Officer will endeavor to respond in a timely fashion to RFIs.
k. The Government reserves the right to issue a change order to expedite the work per FAR Clause 52.243-4, Changes.

1.4 CONTRACTING OFFICER'S RESPONSE TO RFIs

Contracting Officer will respond to RFIs on one of the following forms:

a. Proper RFIs:
   (1) Change Order
   (2) Request for Proposal

b. Improper or Frivolous RFIs:
   (1) Unprocessed RFIs will be returned with a stamp or notation: Not Reviewed.

c. Answers to properly prepared RFIs may be made directly upon the RFI form with supplementary instructions as necessary.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PROCEDURE

3.1.1 RFI Form

Obtain RFI form from the Contracting Officer.

3.1.2 RFI Routing

Submit two hard copies of the completed RFI form to the Contracting Officer and one hard copy to the COR.

The Contracting Officer will respond to proper RFI's as specified.

-- End of Section --
# REQUEST FOR INFORMATION

Please telefax this form to (216) 902-6277 or 6278

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☐ This information is a clarification of the solicitation and does not change the terms or conditions in any way.

☐ This information is a proposed change to the solicitation. An amendment will be issued.

Contracting Officer:
PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of contact personnel

1.2 CONTRACTOR PERSONNEL REQUIREMENTS

1.2.1 Subcontractors and Personnel

Furnish a list of contact personnel of the Contractor and subcontractors, including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.2.2 Contractor Personnel Requirements

Failure to obtain entry approval will not affect the contract price or time of completion.

1.3 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, if a Quality Control (QC) representative is required on the contract, then that individual shall also have fluent English communication skills.

1.4 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the COR to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule prices, shop drawings, and other submittals, scheduling programming, and prosecution of the work. Major subcontractors who will engage in the work shall also attend.

1.5 ELECTRONIC MAIL (E-MAIL) ADDRESS

The Contractor shall establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments in Microsoft, Adobe Acrobat, and other similar formats. Within 10 days after contract award, the Contractor shall provide the Contracting Officer a single (only one) e-mail address for electronic communications from the Contracting Officer related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The Contracting Officer may also use email to notify the
Contractor of base access conditions when emergency conditions warrant, such as hurricanes, terrorist threats, etc. Multiple email address will not be allowed.

It is the Contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office(s). The Contractor shall promptly notify the Contracting Officer, in writing, of any changes to this email address.

PART 2   PRODUCTS

Not used.

PART 3   EXECUTION

Not used.

-- End of Section --
PART 1   GENERAL

1.1   SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
   Project Schedule

PART 2   PRODUCTS (Not Applicable)

PART 3   EXECUTION

3.1   GENERAL REQUIREMENTS

3.1.1   Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. Make the schedule cost loaded and activity coded. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

3.2   PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below.

3.2.1   Project Schedule Submission

Submit the Project Schedule, defining the Contractor's planned operations for approval. Schedule is due 10 calendar days after award. The approved Project Schedule will be used for payment purposes. Completely cost load the Project Schedule to balance the contract award CLINS shown on the Price Schedule.

Schedule shall comply with indicated and specified work restrictions.

3.2.2   Periodic Schedule Updates

Submit periodic schedule updates with each pay request for progress payment or when requested by the Contracting Officer. These submissions will enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.
3.3 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the Contracting Officer: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, the Contractor shall submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

-- End of Section --
PART 1    GENERAL

1.1    DEFINITIONS

1.1.1    Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to commencing work on site.

Certificates of insurance
Surety bonds
List of proposed subcontractors
Construction Progress Schedule
Schedule of prices
Health and safety plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by
the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.
This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.1.2 Approving Authority

Contracting Officer or designated person authorized to approve submittal.

1.1.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2 SUBMITTALS

Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register

1.3 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.3.1 Submittals Required from the Contractor

As soon as practicable after award of contract, and before procurement of fabrication, forward the submittals required in the technical sections of this specification, including shop drawings, product data and samples.

1.3.1.1 O&M Data

The COR will review and approve for the Contracting Officer O&M Data to verify the submittals comply with the contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

a. In the event the Contractor fails to deliver O&M Data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data are applicable.

1.4 PREPARATION

1.4.1 Transmittal Form

See "CONTRACTOR'S TRANSMITTAL FOR SUBMITTAL ACCEPTANCE REQUEST" form attached to this Section. The Government will provide the transmittal form in electronic format.
Transmit each submittal, except sample installations and sample panels to office of approving authority. Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding samples.

The transmittal form includes routing instructions which require both hard copies per contract clauses and portable document format (PDF) submittals to Contracting Officer and COR. The PDF submittals shall be compatible most current version of Adobe Acrobat or similar software capable of producing PDF file format. Larger PDF files may require the use of a secure file transfer protocol (FTP) site acceptable to the Contracting Officer and COR.

1.4.2 Identifying Submittals

When submittals are provided by a lower tier contractor the Prime Contractor is to prepare, review and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier Contractor associated with submittal.

e. Section number of the specification section by which submittal is required.

f. Submittal description (SD) number of each component of submittal.

g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

h. Product identification and location in project.

1.4.3 Format for SD-02 Shop Drawings

a. Shop drawings are not to be less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

b. Present 8 1/2 by 11 inches sized shop drawings as part of the
bound volume for submittals required by section. Present larger drawings in sets.

1.4.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

a. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

b. Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

c. Submit manufacturer's instructions prior to installation.

1.4.5 Format of SD-04 Samples

a. Furnish representative samples unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified.

1.4.6 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

1.4.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

a. Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.

b. Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.4.8 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 00 CLOSEOUT SUMBITTALS for O&M Data format.

1.5 QUANTITY OF SUBMITTALS

1.5.1 Number of Copies of SD-02 Shop Drawings

Submit four hard copies of submittals of shop drawings. Submit PDF copies as specified.

1.5.2 Number of Copies of SD-03 Product Data and SD-08 Manufacturer's Instructions

Submit in compliance with quantity requirements specified for shop drawings.

1.5.3 Number of Samples SD-04 Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.
b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.5.4 Number of Copies SD-05 Design Data and SD-07 Certificates

Submit in compliance with quantity requirements specified for shop drawings.

1.5.5 Number of Copies of SD-10 Operation and Maintenance Data

Submit two copies of O&M Data to the Contracting Officer for review and approval. See Section 01 78 00 CLOSEOUT SUBMITTALS for final submittal requirements.

1.5.6 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit four hard copy sets of administrative submittals. Submit PDF copies as specified.

1.6 SUBMITTAL REGISTER

See initial submittal register attached to this Section. Maintain submittal register, as the work progresses. The Government will provide the initial submittal register in electronic format.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.6.1 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request.

1.7 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register".

b. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 14 calendar days excluding mailing time, for the review process in the Construction Schedule and all project planning. In instances where submittal review must be expedited, the Contractor may annotate the transmittal as "Urgent" and provide a FAX number and email address for prompt return. The Coast Guard will make every effort to accelerate the review of each urgent submittal; however,
the Contractor should not anticipate a reduced time schedule and shall plan project progress accordingly.

c. Period of review for each resubmittal is the same as for initial submittal.

1.8 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

a. Note date on which submittal was received from Contractor.

b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph entitled "Review Notations" and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals. One copy of the approved submittal will be retained by the Contracting Officer and three copies of the submittal will be returned to the Contractor.

1.8.1 Review Notations

Contracting Officer review will be completed within fifteen calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" "or approved except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.9 DISAPPROVED OR REJECTED SUBMITTALS

Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes" is
to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.10 APPROVED/ACCEPTED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.11 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapproved any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

1.12 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required
approvals have not been obtained.

1.13 PROGRESS SCHEDULE

1.13.1 Bar Chart

a. Submit the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference in one reproducible and 4 copies.

b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

c. Include no less than the following information on the progress chart:

(1) Break out by major headings for primary work activity.

(2) A line item break out under each major heading sufficient to track the progress of the work.

(3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.

(4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period.

(5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.

(6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)

d. Update the progress schedule every 30 calendar days throughout the contract performance period.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --
CONTRACTOR’S TRANSMITTAL FOR SUBMITTAL ACCEPTANCE REQUEST

USCG TRACEN YORKTOWN

FROM CONTRACTOR

PROJECT TITLE AND LOCATION

TO

USCG TRACEN YORKTOWN

CONTRACTORS USE ONLY

ITEM NUMBER | PROJ. SPEC. SECT & PARA. and/or PROJ. DWG. NO. | ITEM IDENTIFICATION | NUMBER OF COPIES | ACTION CODES | REVIEWERS INITIALS |
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CONTRACTOR’S COMMENTS

DATE TRANSMITTAL AND SUBMITTAL DATA SENT TO CEU CLEVELAND | CONTRACTOR REPRESENTATIVE (Signature)

DATE RECEIVED BY REVIEWER | FROM (Reviewer) | DATE REVIEW COMPLETE

☐ Submittals are returned with action indicated. Acceptance of an item does not include approval of any deviation from the contract requirements unless the contractor calls attention to and supports the deviation.

☐ Submittals are forwarded to CEU Cleveland with technical reviewer recommendations indicated in REVIEWER’S COMMENTS below or attached to the transmittal form.

REVIEWER’S COMMENTS

COMPLETED REVIEW COPIES TO: (INDIVIDUALS CHECKED BELOW) | DATE | SIGNATURE
|-----------------------------------|-------|---------|

1-Contractor______, 1-Engineer______, 1-Inspector______, 1-A/E______, 1-Contracting Officer______, 1-Cx______

NOTE: Review and acceptance of submittals by the Government is intended to verify general conformance with the design intent as shown on the contract drawings and in the specifications. Acceptance by the Contracting Officer’s Representative does not relieve the Contractor of responsibility for any errors and/or omissions in the submittals, nor from the responsibility for complying with the requirements of the contract, except with respect to variations described and approved in accordance with FAR 52.243-4 CHANGES.

Revised: 20June 2016
Routing instructions for CONTRACTOR’S TRANSMITTAL FOR SUBMITTAL ACCEPTANCE REQUEST

Abbreviations

Function
QC  Quality Control (CTR)
QA  Quality Assurance (TCY)
TR  Technical Reviewer (TCY)
COR  Contracting Officer Representative (TCY)
CO  Contracting Officer (CEU)

Organization
CTR  Contractor
CEU  USCG Civil Engineering Unit – Cleveland
TCY  USCG Training Center Yorktown

General
PDF  Portable document format

Technical Submittal Review Routing

1. CTR prepares submittal
2. QC reviews and approves submittal, prepares transmittal to the government, delivers four hard copies of the submittal to QA, and emails PDF of the submittal to QA and CO.
3. QA receives and dates hard copies of submittal, forwards to TR, saves scanned copy of submittal on server.
4. TR, reviews, comments, codes, initials and dates all copies of hard copy submittals. Redline markup of the submittal will be minimized; written comments are preferred.
5. TR or COR signs and dates all copies of submittal, scans signed transmittal and comments returns reviewed submittals to QA, emails scanned transmittal and comments to QC, QA and CO, files scanned comments on server.
6. QA returns 1 hard copy of submittal to QC, files 2 hard copy for QA/COR, files 1 hard copy for CO.

Administrative Submittal Review Routing

1. CTR prepares submittal
2. QC reviews and approves submittal, prepares transmittal to the government, delivers four hard copies of the submittal to QA, and emails PDF of the submittal to QA and CO.
3. QA receives and dates hard copies of submittal, saves scanned copy of submittal on server.
4. QA, reviews, comments, codes, initials and dates all copies of hard copy submittals. Redline markup of the submittal will be minimized; written comments are preferred.
5. QA or COR signs and dates all copies of submittal, scans signed transmittal and comments, emails scanned transmittal and comments to QC and CO, files scanned comments on server.
6. QA returns 1 hard copy of submittal to QC, files 2 hard copies for QA/COR, files 1 hard copy for CO.
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32 (2012) Fall Protection
ASSE/SAFE A10.34 (2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1 (2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22 (2010) Articulating Boom Cranes
ASME B30.3 (2012) Tower Cranes
ASME B30.5 (2014) Mobile and Locomotive Cranes
ASME B30.8 (2010) Floating Cranes and Floating Derricks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10 (2013) Standard for Portable Fire Extinguishers
NFPA 51B (2014) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70 (2017) National Electrical Code

U.S. ARMY CORPS OF ENGINEERS (USACE)

1.2 DEFINITIONS

a. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

b. High Visibility Accident. Any mishap which may generate publicity or high visibility.

c. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

d. Operating Envelope. The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).

e. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

   (1) Death, regardless of the time between the injury and death, or the length of the illness;

   (2) Days away from work (any time lost after day of injury/illness onset);

   (3) Restricted work;

   (4) Transfer to another job;

   (5) Medical treatment beyond first aid;

   (6) Loss of consciousness; or
(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

f. "USCG" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

   Accident Prevention Plan (APP)
   Crane Critical Lift Plan
   Proof of qualification for Crane Operators

SD-06 Test Reports

   Notifications and Reports
   Submit reports as their incidence occurs, in accordance with the requirements of the paragraph, "Notifications and Reports."
   Accident Reports

SD-07 Certificates

   Confined space entry permit
   Hot work permit

1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.5.1 Personnel Qualifications

1.5.1.1 Crane Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 16 and Appendix I. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitizes of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification.
1.5.2 Meetings

1.5.2.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.5.2.2 Safety Meetings

Conduct and document meetings as required by EM 385-1-1. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractors' daily report.

1.6 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor Quality control Manager, and any designated CSP or CIH.

Submit the APP to the Contracting Officer 10 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.
Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the Contracting Officer's office and at the job site. Continuously review and amend the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.6.1 EM 385-1-1 Contents

In addition to the requirements outlined in Appendix A of USACE EM 385-1-1, the following is required:

a. Names and qualifications (resumes including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be used such as CSPs, CIHs, STSs, CHSTs. Specify the duties of each position.

b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; personal protective equipment and clothing to include selection, use and maintenance.

c. Confined Space Entry Plan. Develop a confined and/or enclosed space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

d. Crane Critical Lift Plan.

Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of
the capacity of a barge mounted mobile crane's hoists) at any radius of
lift; lifts involving more than one crane or hoist; lifts of personnel; and
lifts involving non-routine rigging or operation, sensitive equipment, or
unusual safety risks. Submit 15 calendar days prior to on-site work and
include the requirements of USACE EM 385-1-1, paragraph 16.H. and the
following:

(1) For lifts of personnel, demonstrate compliance with the requirements of
29 CFR 1926.1400.

(2) For barge mounted mobile cranes, barge stability calculations
identifying barge list and trim based on anticipated loading; and load
charts based on calculated list and trim. The amount of list and trim
shall be within the crane manufacturer's requirements.

e. Fall Protection and Prevention (FP&P) Program Documentation. The
program documentation shall be site specific and address all fall
hazards in the work place and during different phases of construction.
Address how to protect and prevent workers from falling to lower levels
when they are exposed to fall hazards above 6 feet. A qualified person
for fall protection shall prepare and sign the program documentation.
Include fall protection and prevention systems, equipment and methods
employed for every phase of work, responsibilities, assisted rescue,
self-rescue and evacuation procedures, training requirements, and
monitoring methods. Revise the Fall Protection and Prevention Program
documentation for lengthy projects, reflecting any changes during the
course of construction due to changes in personnel, equipment, systems
or work habits. Keep and maintain the accepted Fall Protection and
Prevention Program documentation at the job site for the duration of
the project. Include the Fall Protection and Prevention Program
documentation in the Accident Prevention Plan (APP).

The FP&P Plan shall include a Rescue and Evacuation Plan in accordance
with USACE EM 385-1-1, Section 21.M. The plan shall include a detailed
discussion of the following: methods of rescue; methods of self-rescue;
equipment used; training requirement; specialized training for the
rescuers; procedures for requesting rescue and medical assistance; and
transportation routes to a medical facility. Include the Rescue and
Evacuation Plan in the Fall Protection and Prevention (FP&P) Plan, and
as part of the Accident Prevention Plan (APP).

1.7 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE
EM 385-1-1, Section 1.

1.8 DISPLAY OF SAFETY INFORMATION

Within one calendar day(s) after commencement of work, erect a safety
bulletin board at the job site. Where size, duration, or logistics of
project do not facilitate a bulletin board, an alternative method,
acceptable to the Contracting Officer, that is accessible and includes all
mandatory information for employee and visitor review, shall be deemed as
meeting the requirement for a bulletin board. Include and maintain
information on safety bulletin board as required by EM 385-1-1, section
01.A.06. Additional items required to be posted include:

a. Confined space entry permit.
b.  Hot work permit.

1.9  SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.10  EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.11  NOTIFICATIONS and REPORTS

1.11.1  Accident Notification

Notify the Contracting Officer and COR as soon as practical, but no more than four hours after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.11.2  Accident Reports

a.  Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, property damage accidents resulting in at least $20,000 in damages, to establish the root cause(s) of the accident. Complete and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

1.12  HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Safety Officer and COR. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE COR IMMEDIATELY.
1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the COR.

1.14 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.15 CONFINED SPACE ENTRY REQUIREMENTS.

Contractors entering and working in confined spaces while performing general industry work are required to follow the requirements of OSHA 29 CFR 1926 and comply with the requirements in Section 34 of EM 385-1-1, OSHA 29 CFR 1910, and OSHA 29 CFR 1910.146. Obtain a confined space entry permit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with USACE EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be carried/available on each person.

Mandatory PPE includes:

a. Hard Hat

b. Appropriate Safety Shoes

c. Reflective Vests

3.1.1 Hazardous Material Use

Each hazardous material must receive approval from the Contracting Office or their designated representative prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.
3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the COR prior to excepted items of radioactive material and devices being brought on base.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If additional material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer and COR immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Apply for utility outages at least 14 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the COR to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSE/SAFE Z359.1.
3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.B.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraphs 21.N through 21.N.04. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 6 feet of an edge, on low-slope roofs, protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized.

(2) For work greater than 6 feet from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.
b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.4.4 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.6 Rescue and Evacuation Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 SCAFFOLDING

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access scaffold platforms greater than 20 feet maximum in height by use of a scaffold stair system. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than 20 feet maximum in height. The use of an adequate gate is required. Ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Give special care to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Place work platforms on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.
3.6 EQUIPMENT

3.6.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.6.2 Weight Handling Equipment

a. Equip cranes and derricks as specified in EM 385-1-1, section 16.

b. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

c. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

d. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11 and ASME B30.5 or ASME B30.22 as applicable.

f. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available.
for review by COR.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. Prior to conducting lifting operations set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.

3.6.3 Equipment and Mechanized Equipment

a. Proof of qualifications for operator shall be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHA's.

3.7 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.7.1 Utility Locations

All underground utilities in the work area must be positively identified by a third party, independent, private utility locating company in addition to any station locating service and coordinated with the station utility department.

3.7.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within five feet of the underground system.

3.7.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company shall locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to
the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.8 ELECTRICAL

3.9.1 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of EM 385-1-1, NFPA 70E, and OSHA electrical standards.

3.9 WORK IN CONFINED SPACES

Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, OSHA Directive CPL 2.100 and OSHA 29 CFR 1926. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 34 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g. ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph:  847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: http://www.amca.org

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph:  703-524-8800
Fax: 703-562-1942
Internet: http://www.ahrinet.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph:  800-527-4723 or 404-636-8400
Fax: 404-321-5478
E-mail: ashrae@ashrae.org
Internet: http://www.ashrae.org

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)
1800 East Oakton Street
Des Plaines, IL 60018
Ph:  847-699-2929
Internet: http://www.asse.org
Fax: 212-248-5018
E-mail: IES@IES.org
Internet: http://www.IES.org

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-9667
E-mail: onlinesupport@ieee.org
Internet: http://www.ieee.org

INTERNATIONAL CODE COUNCIL (ICC)
500 New Jersey Avenue, NW
6th Floor, Washington, DC 20001
Ph: 800-786-4452 or 888-422-7233
E-mail: order@iccsafe.org
Internet: www.iccsafe.org

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA 22180-4602
Ph: 703-281-6613
E-mail: info@mss-hq.com
Internet: http://mss-hq.org/Store/index.cfm

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)
16712 Elm Circle
Omaha, NE 68130
Ph: 800-747-6422
Fax: 402-330-9702
Internet: http://www.micainsulation.org

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 900
Arlington, VA 22209
Ph: 703-841-3200
Internet: http://www.nema.org/

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)
8575 Grovemont Circle
Gaithersburg, MD 20877
Ph: 301-977-3698
Fax: 301-977-9589
Internet: http://www.nebb.org

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000
Fax: 617-770-0700
Internet: http://www.nfpa.org

PLUMBING-HEATING-COOLING CONTRACTORS ASSOCIATION (PHCC)
180 South Washington Street, Suite 100
Falls Church, VA 22046
Ph: 800-533-7694 or 703-237-8100
Fax: 703-237-7442
E-mail: naphcc@naphcc.org
Internet: http://www.phccweb.org

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)
2000 Powell Street, Suite 600
Emeryville, CA 94608
Ph: 800-326-3228
E-mail: info@SCSglobalservices.com
Internet: http://www.scsglobalservices.com/

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1219
Ph: 703-803-2980
Fax: 703-803-3732
Internet: http://www.smacna.org

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
21865 Copley Drive
Diamond Bar, CA 91765
Ph: 909-396-2000
E-mail: webinquiry@aqmd.gov
Internet: http://www.aqmd.gov

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)
15 Technology Parkway South, Suite 115
Peachtree Corners, GA 30092
Ph: 800-322-8686 or 770-446-1400
Fax: 770-446-6947
E-mail: memberconnection@tappi.org
Internet: http://www.tappi.org

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
1320 N. Courthouse Rd., Suite 200
Arlington, VA 22201
Ph: 703-907-7700
Fax: 703-907-7727
Internet: http://www.tiaonline.org

U.S. ARMY CORPS OF ENGINEERS (USACE)
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Internet: http://www.publications.usace.army.mil/
or
http://www.hnc.usace.army.mil/Missions/Engineering/TECHINFO.aspx

U.S. DEPARTMENT OF DEFENSE (DOD)
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Obtain Military Specifications, Standards and Related Publications from:
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Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph:  215-697-6396 - for account/password issues
Internet:  http://assist.daps.dla.mil/online/start/; account registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, DC 20005
Ph:  202-289-7800
Fax: 202-289-1092
Internet:  http://www.wbdg.org/references/docs_refs.php

U.S. DEPARTMENT OF ENERGY (DOE)
1000 Independence Avenue Southwest
Washington, D.C. 20585
Internet:  www.eere.energy.gov

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph:  866-272-6272
Fax: 301-837-0483
Internet:  http://www.archives.gov
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Washington, DC 20401
Ph:  202-512-1800
Fax:  202-512-2104
E-mail:  contactcenter@gpo.gov
Internet:  http://www.gpoaccess.gov

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542
Ph:  877-854-3577
E-mail:  CEC.us@us.ul.com
Internet:  http://www.ul.com/
UL Directories available through IHS at http://www.ihs.com

PART 2   PRODUCTS

Not used
PART 3 EXECUTION

Not used

-- End of Section --
PART 1   GENERAL

1.1 QUALITY CONTROL

The contractor is responsible for Quality Control.

1.2 WORKMANSHIP

Comply with industry standards unless noted or specified requirements indicate more rigid standards or more precise workmanship. Perform work by persons qualified to produce workmanship of specified quality.

1.3 MANUFACTURER'S INSTRUCTIONS

Comply with instructions in full detail, including each step in sequence. Should instructions conflict with contract documents, request and receive clarification from the Contracting Officer before proceeding.

1.4 MANUFACTURER'S CERTIFICATION OF COMPLIANCE

When required in an individual specification section, submit manufacturer's certificate according to specification section 01 33 00, "Submittal Procedures", certifying that products meet or exceed specified requirements, executed by responsible officer. Format shall include specification section, paragraph number, and name of product. Variations shall be noted.

1.5 INSPECTIONS

a. Contractor shall provide all necessary equipment, instruments, qualified personnel, and facilities to perform all inspections and certifications specified in the individual specification sections.

b. An authorized representative of the Contracting Officer, COR, will make periodic visits to the project. In order to prevent construction delays, provide a minimum 2 days notice to the COR before covering up work requiring Government inspection or covering up work that will be the basis of a partial payment.

1.6 PROJECT COMPLETION INSPECTIONS

1.6.1 Final Inspection

The contractor shall request in writing a Final Inspection by the government. The written request shall be submitted to the COR a minimum of 7 days prior to the proposed final inspection date. The COR will perform this inspection to determine if the facility is complete and ready to be accepted/occupied. If it is determined that the facility is not complete and ready to be accepted/occupied, the Government will issue a "Final Punch List" listing the incomplete items/discrepancies found during the inspection. The contractor shall complete all items on the "Final Punch List" within 14 calendar days after receiving the punch list. If the government finds the facility not ready for a Final Inspection, the inspection will be canceled and the contractor shall
reschedule the Final Inspection once the facility is ready. The government will issue a brief/general explanation to the contractor explaining why the facility was not considered ready for a Final Inspection. If the facility is complete and there is no "Final Punch List" the government will accept and take beneficial occupancy of the facility. The warranty period will start on the date the facility is accepted.

1.6.2 Final Acceptance Inspection

The contractor shall request in writing a Final Acceptance Inspection by the government once the facility is complete and all items on the "Final Punch List" have been completed. The written request shall be submitted to the Contracting Officer and COR a minimum of 2 days prior to the proposed inspection date. If the facility is complete and all items on the "Final Punch List" are complete, the government will accept and take occupancy of the facility. If the facility is not complete, and all items on the Final Punch List have not been completed, the government will not accept or take beneficial occupancy of the facility. The contractor shall reschedule the Final Acceptance Inspection once the facility is complete and all items on the Final Punch List have been completed. Acceptance and beneficial occupancy shall take place before or on the contract completion date, or the contractor will be subject to liquidated damages. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction FAR 52.246-12". The warranty period will start on the date the facility is accepted.

1.7 NOTIFICATION ON NON-COMPLIANCE

The Contracting Officer or COR will notify the Contractor of any detected non-compliance with the foregoing requirements and the contract specifications. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time for excess costs or damages by the Contractor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.
PART 1  GENERAL

1.1  SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 70  (2017) National Electrical Code

PART 2  PRODUCTS

2.1  TEMPORARY SIGNAGE

2.1.1  Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the COR.

2.2  TEMPORARY TRAFFIC CONTROL

2.2.1  Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.2  Fencing

a. Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to be able to restrain a force of at least 250 pounds against it.
2.2.3 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the COR. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Utilities at Special Locations

a. Reasonable amounts of utilities will be made available without charge. The Contractor will be responsible for making connections, providing transformers and meters, and making disconnections; and for providing backflow preventer devices on connections to domestic water lines. Under no circumstances will taps to base fire hydrants be allowed for obtaining domestic water.

3.2.3 Sanitation

a. Provide temporary sanitation facilities that are self-contained units with both urinals and stool capabilities. Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the COR. The doors shall be self-closing. Locate the facility behind the construction fence or out of the public view.

3.2.4 Telephone

Make arrangements and pay all costs for telephone facilities desired.

3.2.5 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

a. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain...
approval from the COR prior to starting any activity that will obstruct traffic.

b. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, or COR.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.4 CONTRACTOR'S TEMPORARY FACILITIES

3.4.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the COR. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.4.2 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

3.4.3 Storage Area

Do not place or store Trailers, materials, or equipment outside the storage area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the COR away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.
3.4.4 Supplemental Storage Area

Upon Contractor's request, the COR will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor is responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

3.4.5 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the COR, require exterior painting or maintenance will not be allowed on installation property.

b. Paint using suitable paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.4.6 Trailers or Storage Buildings

a. Trailers or storage buildings will be permitted, where space is available, subject to the approval of the COR. The trailers or buildings shall be in good condition, free from visible damage rust and deterioration, and meet all applicable safety requirements. Trailers shall be roadworthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at the Contractor's expense. A sign not smaller than 24 by 24 inches shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers.

3.4.7 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

b. Cut grass (or annual weeds) within the construction and storage sites to a maximum 4 inch height at least once a week during the growing season unless the grass area is not visible to the public. Trim the grass around fences at time of grass cutting. Maintain grass or weeds on stockpiled earth as described above.

3.4.8 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary
facilities. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

3.4.9 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.4.9.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

3.4.9.2 Hurricane Condition of Readiness

Unless directed otherwise, comply with:

a. Condition FOUR (Sustained winds of 50 knots or greater expected within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 4 feet high. Remove all debris, trash, or objects that could become missile hazards. Contact COR for of Readiness (COR) updates and completion of required actions.

b. Condition THREE (Sustained winds of 50 knots or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness. Contact COR for weather and COR updates and completion of required actions.

c. Condition TWO (Sustained winds of 50 knots or greater expected within 24 hours): Curtail or cease routine activities until securing operation is complete. Reinforce or remove form work and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact COR for weather and Condition of Readiness (COR) updates and completion of required actions.

d. Condition ONE. (Sustained winds of 50 knots or greater expected within 12 hours): Secure the jobsite, and leave Government premises.
3.5 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stacked stored materials not in trailers, whether new or salvaged.

3.6 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haulroads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

WETLAND MANUAL

Corps of Engineers Wetlands Delineation
Manual Technical Report Y-87-1

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328  Definitions of Waters of the United States
40 CFR 112  Oil Pollution Prevention
40 CFR 261  Identification and Listing of Hazardous Waste
40 CFR 262  Standards Applicable to Generators of Hazardous Waste
40 CFR 279  Standards for the Management of Used Oil
49 CFR 171 - 178  Hazardous Materials Regulations

1.2  DEFINITIONS

1.2.1  Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.2  Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.3  Environmental Protection

Environmental protection is the prevention/control of pollution and habitat
disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor must discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Land Application must be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.5 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.6 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.7 Wetlands

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

1.3 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. Any delays resulting from failure to comply with environmental laws and regulations will be the Contractor's responsibility.

1.4 SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. Payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor, and payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations are the Contractor's responsibility. All costs associated
with this section must be included in the contract price.

1.6 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations from the drawings, plans and specifications, requested by the Contractor and which may have an environmental impact, will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.7 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. After receipt of such notice, the Contractor will inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

Obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations is the Contractor's responsibility.

3.2 LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Identify any land resources to be preserved within the work area prior to the beginning of any construction. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval, except in areas indicated on the drawings or specified to be cleared. Ropes, cables, or guys will not be fastened to or attached to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times, as defined in the following subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

3.2.1 Work Area Limits

Mark the areas that need not be disturbed under this contract prior to commencing construction activities. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. The Contractor's personnel must be knowledgeable of the
purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved must be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the COR. Temporary movement or relocation of Contractor facilities will be made only when approved. Erosion and sediment controls must be provided for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas must be controlled to protect adjacent areas.

3.3 WATER RESOURCES

Monitor all water areas affected by construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. For construction activities immediately adjacent to impaired surface waters, the Contractor must be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.4 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; must be controlled at all times, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities must be controlled at all times. The odors must be in compliance with State regulations and/or local ordinances and may not constitute a health hazard.
3.4.3 Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise.

3.4.4 Burning

Burning is prohibited on the Government premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall comply with 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT and as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Place solid wastes (excluding clearing debris) in containers which are emptied on a regular schedule. Handling, storage, and disposal must be conducted to prevent contamination. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with solid waste. Transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill will be the minimum acceptable offsite solid waste disposal option. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

3.5.2 Chemicals and Chemical Wastes

Dispense chemicals ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. This documentation will be periodically reviewed by the Government. Collect chemical waste in corrosion resistant, compatible containers. Collection drums must be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes will be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 – 178. At a minimum, manage and store hazardous waste in compliance with 40 CFR 262. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. Segregate hazardous waste from other materials and wastes, protect it from the weather by placing it in a safe covered location, and take precautionary measures such as berming or other appropriate measures against accidental spillage. Storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 – 178, State, and local laws and regulations is the Contractor’s responsibility. Transport Contractor generated hazardous waste off Government property within 30 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. Dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials must be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to
spills are the Contractor's responsibility.

3.5.4 Petroleum, Oil, Lubricant Storage

Storage, fueling and lubrication of equipment and motor vehicles must be conducted in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with 40 CFR 112, all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded must be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Any fuel storage tank brought on-site shall be less than 500 gallon capacity and have weatherproof secondary containment integral to the tank design/configuration.

3.5.5 Waste Water

Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. will not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. Dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

3.6 RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

3.7 MAINTENANCE OF POLLUTION FACILITIES

Maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.8 POST CONSTRUCTION CLEANUP

The Contractor will clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up" FAR 52.236-12. Unless otherwise instructed in writing by the Contracting Officer or COR, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area must be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or
proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

-- End of Section --
PART 1  GENERAL

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

1.2 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. The Contractor shall be responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the project. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste, consider the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. Implement any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan

SD-11 Closeout Submittals

Records

1.4 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer's Representative to discuss the proposed Waste
Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section01 45 02 QUALITY CONTROL. At a minimum, discuss environmental and waste management goals and issues at the following additional meetings:

a. Pre-bid meeting.
b. Preconstruction meeting.
c. Regular site meetings.
d. Work safety meetings.

1.5 WASTE MANAGEMENT PLAN

Submit a waste management plan within 15 days after contract award and not less than 10 days before the preconstruction meeting. The plan demonstrates how to meet the project waste diversion goal. Also, include the following in the plan:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.
c. Description of the regular meetings to be held to address waste management.
d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.
e. Characterization, including estimated types and quantities, of the waste to be generated.
f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.
g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.
h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Identify the recycling facilities by name, location, and phone number, including a copy of the permit or license for each facility.
i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.
j. Description of the means by which any waste materials identified in
item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the COR. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, and the COR.

1.6 RECORDS

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. Make the records available to the Contracting Officer's Representative during construction, and deliver to the Contracting Officer's Representative upon completion of the construction.

1.7 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and handle recyclable materials to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. Separate materials by one of the following methods:

1.7.1 Source Separated Method.

Separate waste products and materials that are recyclable from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further
Repair HVAC & Reconfigure Intel SCIF

processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).
   (1) Ferrous.
   (2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.
   (1) Bond.
   (2) Newsprint.
   (3) Cardboard and paper packaging materials.

i. Plastic.

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<tr>
<td>2</td>
<td>High Density Polyethylene (HDPE)</td>
</tr>
<tr>
<td>3</td>
<td>Vinyl (Polyvinyl Chloride or PVC)</td>
</tr>
<tr>
<td>4</td>
<td>Low Density Polyethylene (LDPE)</td>
</tr>
<tr>
<td>5</td>
<td>Polypropylene (PP)</td>
</tr>
<tr>
<td>6</td>
<td>Polystyrene (PS)</td>
</tr>
<tr>
<td>7</td>
<td>Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.</td>
</tr>
</tbody>
</table>

SECTION 01 74 19 Page 4
1. Carpet.

1.7.2 Co-Mingled Method.

Place waste products and recyclable materials into a single container and then transport to a recycling facility where the recyclable materials are sorted and processed.

1.7.3 Other Methods.

Other proposed methods may be used when approved by the Contracting Officer.

1.8 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, dispose of in accordance with the following:

1.8.1 Reuse.

Give first consideration to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Consider sale or donation of waste suitable for reuse.

1.8.2 Recycle.

Recycle waste materials not suitable for reuse, but having value as being recyclable. Recycle all fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.8.3 Waste.

Dispose of materials with no practical use or economic benefit to waste-to-energy plants where available. As the last choice, dispose of materials at a landfill or incinerator.

1.8.4 Return.

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --
PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


GREEN SEAL (GS)

GS-37 (2012) Cleaning Products for Industrial and Institutional Use

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Spare Parts Data

Two copies of list that indicates manufacturer's name, part number, nomenclature, and stock level recommended for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

SD-08 Manufacturer's Instructions

Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

Define within the schedule the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements. On each test feature; e.g., gpm, rpm, psi, provide a signoff blank for the Contractor and Contracting Officer. Within a remarks column of the testing validation procedure include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration,
velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, condition monitoring (predictive testing) and inspection, adjustment, lubrication and cleaning necessary to prevent failure.

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance Manuals," of this section.

SD-11 Closeout Submittals

Record Drawings

Drawings showing final as-built conditions of the project. The manually prepared drawings must consist of 1 set of completed final as-built red-line prints.

1.3 PROJECT RECORD DOCUMENTS

1.3.1 Record Drawings

This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions.

1.3.1.1 Working Record and Final Record Drawings

Revise 1 set of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Kep these working as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Prepare final record (as-built) drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final record (as-built) drawings will be jointly reviewed for accuracy and completeness by the COR and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final record drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. Show on the working and final record drawings, but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances
by dimensioning along the utility run from a reference point. Also record
the average depth below the surface of each run.

b. The location and dimensions of any changes within the building
structure.

c. Correct grade, elevations, cross section, or alignment of roads,
earthwork, structures or utilities if any changes were made from contract
plans.

d. Changes in details of design or additional information obtained
from working drawings specified to be prepared and/or furnished by the
Contractor; including but not limited to fabrication, erection,
installation plans and placing details, pipe sizes, insulation material,
dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed
or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, show
only the option selected for construction on the final as-built prints.

h. If borrow material for this project is from sources on Government
property, or if Government property is used as a spoil area, furnish a
contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC
controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (include within change order price the cost to
change working and final record drawings to reflect modifications) and
compliance with the following procedures.

  (1) Follow directions in the modification for posting descriptive
      changes.

  (2) Place a Modification Delta at the location of each deletion.

  (3) For new details or sections which are added to a drawing,
      place a Modification Delta by the detail or section title.

  (4) For minor changes, place a Modification Delta by the area
      changed on the drawing (each location).

  (5) For major changes to a drawing, place a Modification Delta by
      the title of the affected plan, section, or detail at each
      location.

  (6) For changes to schedules or drawings, place a Modification
      Delta either by the schedule heading or by the change in the
      schedule.

  (7) The Modification Delta size shall be 1/2 inch diameter unless
      the area where the circle is to be placed is crowded. Smaller
      size circle shall be used for crowded areas.
1.3.1.3 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and must be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.3.1.2 Payment

No separate payment will be made for record drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.3.2 As-Built Record of Equipment and Materials

Provide completed Equipment Enrollment Form (EEF) as specified in Section 01 80 00 FACILITY PREVENTATIVE MAINTENANCE PROGRAM (FPMP).

1.4 SPARE PARTS DATA

Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

1.5 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and COR for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.6 WARRANTY MANAGEMENT

1.6.1 Performance Bond

The Contractor's Performance Bond must remain effective throughout the construction period. See contract clauses.
1.7 OPERATION AND MAINTENANCE MANUALS

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Bind information in manual format and grouped by technical sections. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

Submit 2 hard copies and 1 electronic copy in portable document format (PDF) compatible with the most current version Adobe Acrobat of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.8 CLEANUP

Provide final cleaning in accordance with ASTM E 1971. Leave premises "broom clean." Comply with GS-37 for general purpose cleaning and bathroom cleaning. Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Replace filters of operating equipment. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with the Waste Management Plan. Promptly and legally transport and dispose of any trash. Do not burn, bury, or otherwise dispose of trash on the project site.
PART 1  GENERAL

1.1 PURPOSE

The intent of this section is for the Contractor to complete the Equipment Enrollment Form (EEF) spreadsheet for systems that have been installed or demolished under this project and are listed in the USCG Approved Equipment Enrollment Catalog. Both the USCG Approved Equipment Enrollment Catalog and Equipment Enrollment Form (EEF) are provided as Reference Documents in the solicitation.

1.2 PRICE AND PAYMENT

The Contractor shall assign a value of $5,000 for the Equipment Enrollment Form (EEF) acceptance in the Schedule of Prices submittal under Section 01 20 00 PRICE and PAYMENT PROCEDURES. No partial payment is allowed for incomplete or unapproved submittals.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1557 (2009) Standard Classification for Building Elements and Related Sitework—UNIFORMAT III

1.4 SEQUENCING AND SCHEDULING

Equipment Enrollment Form (EEF) shall be submitted in hard copy format prior to submittal of Division 1 Operation and Maintenance Manuals. Approved hard copy of the EEF shall be included in the final Operation and Maintenance Manual. Upon acceptance, an electronic format as EEF Excel Spreadsheet file shall be submitted to the Government.

1.5 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

Equipment Enrollment Form. At a minimum, include the following:

HVAC Systems
Electrical Systems
Any machinery or equipment installed as part of this contract

EEF Excel Spreadsheet
1.6 QUALITY ASSURANCE

The EEF shall follow ASTM E1557 UNIFORMAT II Level 4 designations for components installed under the contract. Resources are available from the COR as follows:

a. CEUC Equipment Enrollment Form.xlsx (as an Excel Spreadsheet)
b. CEUC USCG Approved Equipment Enrollment Catalog.pdf (as PDF File)

1.6.1 Pre-Construction Conference

Include Preparation of the EEF in the Pre-construction Conference agenda for discussion.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PREPARATION

Equipment Enrollment Form (EEF) Requirements:

3.1.1 Form Fields

The following fields are listed on the form and shall be completely filled out except where otherwise noted on the Equipment Enrollment Form. The actual equipment attribute list below may change slightly prior to the actual start of this enrollment task.

a. UNIFORMAT II Level IV Classification

b. Component Type (Assigned from USCG Approved Equipment Enrollment Catalog (column D)

c. Physical Location, broken down by Floor, and Room #.

d. Manufacturer Name

e. Model Number

f. Serial #

g. Installation Date

h. Purchase Price (Cost of equipment, labor, shipping)

i. Replacement Costs (Cost of equipment only)

j. Warranty Expiration Date

k. Equipment Attributes (Name Plate information typically indicating Size, Flow, Volume, Pressure, etc.)
3.1.2 Multiple Buildings or Structures

Only equipment from a single building and/or structure is allowed per Equipment Enrollment Form (EEF).

3.1.3 Equipment in the USCG Approved Equipment Enrollment Catalog

Equipment identified for maintenance by O&M manuals but not listed in the USCG Approved Equipment Enrollment Catalog shall also be cataloged per ASTM E 1557 and listed on the Equipment Enrollment Form. If the equipment is not listed in ASTM E1557, consult the Coast Guard (COR) for the proper naming convention.

-- End of Section --
# Equipment Enrollment Form

To be filled out by Government (shaded blocks)

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<td>63100</td>
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<td>CAIFIELD HALL 229</td>
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To be filled out by Contractor (white blocks)

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<th>Floor</th>
<th>Room #</th>
<th>Manufacturer Name</th>
<th>Model #</th>
<th>Install Date</th>
<th>Purchase Price</th>
<th>Replacement Cost</th>
<th>Warranty Expiration Date</th>
<th>Equipment Attributes</th>
<th>GS SAM “JOB PLAN”</th>
<th>PM Job Plan(s) w/ Frequency</th>
<th>Data Entry Use Only</th>
</tr>
</thead>
</table>

Note: NEW, or EQ# if decommissioned

Uniformat II Level 4 (See USCG Approved Equipment Enrollment Catalog, Column A)

Component Type (See USCG Approved Equipment Enrollment Catalog, Column D)

Physical Location

General Instructions:
1. For new equipment, just enter NEW and complete rest of fields. For decommissioned equipment, include equipment number and description; other fields are not required.
2. Purchase Price: Total cost of installation to include cost of equipment, labor, shipping, etc...
3. Replacement Cost: Cost of equipment only.
4. Column references identified refer back to the USCG Approved Equipment Enrollment Catalog.

06/11/20
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<th>Uniformat II Level 4</th>
<th>Material/Equipment Category</th>
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<th>UOM</th>
<th>From RS MEANS FMRCD Manual</th>
<th>From U. S. Coast Guard SAM database</th>
</tr>
</thead>
<tbody>
<tr>
<td>B201003</td>
<td>REVOLVING DOORS</td>
<td>Assemblies include all revolving doors at exterior of the facility.</td>
<td>Revolving Door, Manual</td>
<td>EA</td>
<td>820353001950 Door, Revolving, Manual</td>
<td>Y 1723-S 30</td>
</tr>
<tr>
<td>B201003</td>
<td>REVOLVING DOORS</td>
<td>Assemblies include all revolving doors at exterior of the facility.</td>
<td>Revolving Door, Electric</td>
<td>EA</td>
<td>820353002950 Door, Revolving, Electric</td>
<td>Y 1727-S 30</td>
</tr>
<tr>
<td>B201004</td>
<td>OVERHEAD AND ROLL-UP DOORS</td>
<td>Overhead and roll-up doors installed in exterior walls or exterior skin. Assemblies include frames, hardware, hoisting devices, and finish and other associated work. The unit of measure at the assembly level is each door.</td>
<td>Overhead Rollup Door, Manual, up to 24'H x 25'W</td>
<td>SF</td>
<td>820354001950 Door, overhead, manual, up to 24'H x 25'W</td>
<td>Y 1655-S 30</td>
</tr>
<tr>
<td>B201004</td>
<td>OVERHEAD AND ROLL-UP DOORS</td>
<td>Overhead and roll-up doors installed in exterior walls or exterior skin. Assemblies include frames, hardware, hoisting devices, and finish and other associated work. The unit of measure at the assembly level is each door.</td>
<td>Overhead Rollup Door, Electric, up to 24'H x 25'W</td>
<td>SF</td>
<td>82035401950 Door, overhead, roll-up, electric, up to 24'H x 25'W</td>
<td>Y 1656-S 30</td>
</tr>
<tr>
<td>B201004</td>
<td>OVERHEAD AND ROLL-UP DOORS</td>
<td>Overhead and roll-up doors installed in exterior walls or exterior skin. Assemblies include frames, hardware, hoisting devices, and finish and other associated work. The unit of measure at the assembly level is each door.</td>
<td>Overhead Rollup Door, Shutter, Electric</td>
<td>SF</td>
<td>820354501950 Shutter, roll-up, electric</td>
<td>Y 1733-A 30</td>
</tr>
<tr>
<td>B201005</td>
<td>HANGAR DOORS</td>
<td>Large aircraft doors used on medium and high bay hangars. Assemblies would include frames, hardware, hoisting devices, and finish and other associated work.</td>
<td>Hangar Door, Sliding</td>
<td>SF</td>
<td>82035102950 Door, sliding</td>
<td>Y 1721-Q 1716-A 40</td>
</tr>
<tr>
<td>B201006</td>
<td>BLAST RESISTANT DOORS</td>
<td>Special exterior doors used for blast resistance. Assemblies would include frames, hardware, hoisting devices, and finish and other associated work.</td>
<td>Blast Resistant Door, Hurricane Shutters</td>
<td>SF</td>
<td>N/A Hurricane Shutters/blast resistant door</td>
<td>Y 5042-A 30</td>
</tr>
<tr>
<td>B301001</td>
<td>HIGH SLOPE ROOF COVERINGS</td>
<td>Assemblies include roof coverings, such as shingle, wood shake, and standing seam, etc.</td>
<td>Roof, High Sloped</td>
<td>SF</td>
<td>N/A Roof</td>
<td>Y 6440-A 30</td>
</tr>
<tr>
<td>B301002</td>
<td>LOW SLOPE MEMBRANE SYSTEMS</td>
<td>Assemblies include roof coverings, such as built-up, elastomeric, modified bitumen, etc. Also, walkways or work areas (used to gain access to rooftop equipment) will be included here.</td>
<td>Roof, Low Sloped</td>
<td>SF</td>
<td>N/A Roof</td>
<td>Y 9068-A 20</td>
</tr>
<tr>
<td>B301099</td>
<td>OTHER ROOFING</td>
<td>Roofing not described by the assembly categories listed above.</td>
<td>Roof</td>
<td>SF</td>
<td>N/A Roof</td>
<td>Y 9069-A 30</td>
</tr>
<tr>
<td>C102003</td>
<td>FIRE DOORS</td>
<td>Assemblies include all interior fire doors, including all necessary frames, and sensing devices integral with doors. Interior door hardware is located in C102007, Interior Door Hardware.</td>
<td>Fire Door, Swinging</td>
<td>LEF</td>
<td>C10251101950 Fire Door, swinging</td>
<td>Y 1738-Q 30</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Reference Number</th>
<th>Description</th>
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<tr>
<td>FIRE DOORS</td>
<td>4</td>
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<td>FIRE DOORS</td>
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<td>INTERIOR OVERHEAD DOORS</td>
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<td>INTERIOR OVERHEAD DOORS</td>
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<td>PASSENGER ELEVATORS</td>
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<td>PASSENGER ELEVATORS</td>
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<tr>
<td>FREIGHT ELEVATORS</td>
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<td>FREIGHT ELEVATORS</td>
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<tr>
<td>WHEELCHAIR LIFT</td>
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<td>WHEELCHAIR LIFT</td>
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<tr>
<td>MOVING STAIRS AND WALKS</td>
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<td>MOVING STAIRS AND WALKS</td>
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<tr>
<td>OVERHEAD CRANES</td>
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<td>OVERHEAD CRANES</td>
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</tr>
<tr>
<td>CONVEYORS</td>
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<td>CONVEYORS</td>
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<tr>
<td>PHLEGMATIC TUBE SYSTEMS</td>
<td>2</td>
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<td>PHLEGMATIC TUBE SYSTEMS</td>
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</table>

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## USCG Approved Equipment Enrollment Catalog -
Existing SAM Maintained Equipment*

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<td>RS Means/Reference Description</td>
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<td>PM</td>
<td>Existing SAM Job Plan Numbers</td>
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<tr>
<td>D0007</td>
<td>OVERHEAD CRANES</td>
<td>Overhead cranes.</td>
<td>Crane, electric bridge, over 15 tons</td>
<td>EA</td>
<td>E10951223950</td>
<td>Crane, electric bridge, over 15 tons</td>
</tr>
<tr>
<td>D0007</td>
<td>OVERHEAD CRANES</td>
<td>Overhead cranes.</td>
<td>Crane, manual bridge, up to 5 tons</td>
<td>EA</td>
<td>E10951231950</td>
<td>Crane, manual bridge, up to 5 tons</td>
</tr>
<tr>
<td>D0007</td>
<td>OVERHEAD CRANES</td>
<td>Overhead cranes.</td>
<td>Crane, manual bridge, 5 to 15 tons</td>
<td>EA</td>
<td>E10951232950</td>
<td>Crane, manual bridge, 5 to 15 tons</td>
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<tr>
<td>D0007</td>
<td>OVERHEAD CRANES</td>
<td>Overhead cranes.</td>
<td>Crane, manual bridge, over 15 tons</td>
<td>EA</td>
<td>E10951233950</td>
<td>Crane, manual bridge, over 15 tons</td>
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<tr>
<td>D0099</td>
<td>OTHER MATERIAL HANDLING SYSTEMS</td>
<td>Material handling systems not described in the assembly categories</td>
<td>Hydraulic Lift (Automotive), General (Shop Post Lifts)</td>
<td>EA</td>
<td>E10351001950</td>
<td>Hydraulic lift, Automotive</td>
</tr>
<tr>
<td>D2002</td>
<td>EMERGENCY FIXTURES</td>
<td>Emergency fixtures not described by the assembly categories listed above</td>
<td>Eyewash Station &amp; Shower</td>
<td>EA</td>
<td>N/A</td>
<td>Eyewash Station &amp; Shower</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Butterfly Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D20251201950</td>
<td>Valve, butterfly, automatic, above 4&quot;</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Butterfly Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D20251202950</td>
<td>Valve, butterfly, auto, above 4&quot;</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Check Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D20251251950</td>
<td>Valve, check, above 4&quot;</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Backflow Preventer, up to 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D40151001950</td>
<td>Backflow prevention device, up to 4&quot;</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Backflow Preventer, over 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D40151002950</td>
<td>Backflow prevention device, over 4&quot;</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Ball Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D20251301950</td>
<td>Valve, cock, ball, above 4&quot;</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Diaphragm Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D20251351950</td>
<td>Valve, diaphragm, above 4&quot;</td>
</tr>
<tr>
<td>D2002</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Gate Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>D20251401950</td>
<td>Valve, Gate Above 4&quot;</td>
</tr>
</tbody>
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<tr>
<td>0.202.02</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Globe Valve, above 4&quot; (not included in a system)</td>
<td>EA</td>
<td>D0205145950 Valve, globe, manual, above 4&quot;</td>
<td>Y 2001-A A 25</td>
</tr>
<tr>
<td>0.202.02</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Globe Valve, above 4&quot; (not included in a system)</td>
<td>EA</td>
<td>D02051452950 Valve, globe, auto, above 4&quot;</td>
<td>Y 2002-A A 25</td>
</tr>
<tr>
<td>0.202.02</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>Motor Operated Valve, above 4&quot; (not included in a system)</td>
<td>EA</td>
<td>D0205150950 Valve, motor operated, above 4&quot;</td>
<td>Y 2003-S S 25</td>
</tr>
<tr>
<td>0.202.02</td>
<td>VALVES AND HYDRANTS</td>
<td>Assemblies include all valves and hydrants. Hose bibbs are included in this assembly. The unit of measure at the assembly level is number of valves and hydrants.</td>
<td>OS&amp;Y Valve, above 4&quot; (not included in a system)</td>
<td>EA</td>
<td>D0205155950 Valve, OS&amp;Y (outside stem and yoke) above 4&quot;</td>
<td>Y 2004-A A 25</td>
</tr>
<tr>
<td>0.202.03</td>
<td>DOMESTIC WATER EQUIPMENT</td>
<td>This assembly includes equipment associated with the domestic water supply, including fittings, and specialties required for hookup. Assemblies include hot water heaters, water treatment plants, that is, water softeners, filters, distillers, etc.; pumps directly associated with domestic water supply; and tanks for the potable hot or cold water system. The unit of measure at the assembly level is pieces of equipment.</td>
<td>Water Heater, Solar, closed loop, up to 6 panels</td>
<td>EA</td>
<td>D0205190950 Water Heater, Solar, closed loop, up to 6 panels</td>
<td>Y 1696-S 1702-A 1658-S 1661-A 25</td>
</tr>
<tr>
<td>0.202.03</td>
<td>DOMESTIC WATER EQUIPMENT</td>
<td>This assembly includes equipment associated with the domestic water supply, including fittings, and specialties required for hookup. Assemblies include hot water heaters, water treatment plants, that is, water softeners, filters, distillers, etc.; pumps directly associated with domestic water supply; and tanks for the potable hot or cold water system. The unit of measure at the assembly level is pieces of equipment.</td>
<td>Water Heater, Gas, to 120 Gallon</td>
<td>EA</td>
<td>D0205260950 Water Heater, Gas, to 120 Gallon</td>
<td>Y 1696-S 1702-A 1658-S 1661-A 25</td>
</tr>
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<tbody>
<tr>
<td>0.2020/03</td>
<td>DOMESTIC WATER EQUIPMENT</td>
<td>This assembly includes equipment associated with the domestic water supply, including fittings, and specialties required for hookup. Assemblies include hot water heaters, water treatment plant; filters, distillers, etc.; pumps directly associated with domestic water supply; and tanks for the potable hot or cold water system.</td>
<td>Water Heater, Oil fired to 100 gals</td>
<td>EA</td>
<td>D20205260.2950</td>
<td>Y 1662 - 1666-A</td>
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<tr>
<td>0.2020/03</td>
<td>DOMESTIC WATER EQUIPMENT</td>
<td>This assembly includes equipment associated with the domestic water supply, including fittings, and specialties required for hookup. Assemblies include hot water heaters, water treatment plant; filters, distillers, etc.; pumps directly associated with domestic water supply; and tanks for the potable hot or cold water system.</td>
<td>Water Heater, steam coil, to 2500 gals</td>
<td>EA</td>
<td>D20205260.3950</td>
<td>Y 1667 - 1669-A</td>
</tr>
<tr>
<td>0.2020/03</td>
<td>DOMESTIC WATER EQUIPMENT</td>
<td>This assembly includes equipment associated with the domestic water supply, including fittings, and specialties required for hookup. Assemblies include hot water heaters, water treatment plant; filters, distillers, etc.; pumps directly associated with domestic water supply; and tanks for the potable hot or cold water system.</td>
<td>Water Heater, Electric</td>
<td>EA</td>
<td>D20205260.3950</td>
<td>Y 6576-S</td>
</tr>
<tr>
<td>0.2020/05</td>
<td>SPECIALTIES</td>
<td>Any other special items associated with domestic water supply. All associated work items, including pipes, fittings, valves, insulation, and hookup should be included in this assembly. The unit of measure at the assembly level is pieces of special equipment.</td>
<td>Pressure Relief Valve, above 4&quot; (not included in a system)</td>
<td>EA</td>
<td>D20205262.1950</td>
<td>Y 2005-A</td>
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<tr>
<td>0.202005</td>
<td>SPECIALTIES</td>
<td>Any other special items associated with domestic water supply. All associated work items, including pipes, fittings, valves, insulation, and hookup should be included in this assembly. The unit of measure at the assembly level is pieces of special equipment.</td>
<td>Pressure Regulator Valve &gt; 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>02025265 1950</td>
<td>Valve, pressure regulator, above 4&quot;</td>
</tr>
<tr>
<td>0.202005</td>
<td>SPECIALTIES</td>
<td>Any other special items associated with domestic water supply. All associated work items, including pipes, fittings, valves, insulation, and hookup should be included in this assembly. The unit of measure at the assembly level is pieces of special equipment.</td>
<td>Sediment Strainer Valve &gt; 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>02025270 1950</td>
<td>Valve, sediment strainer, above 4&quot;</td>
</tr>
<tr>
<td>0.202005</td>
<td>SPECIALTIES</td>
<td>Any other special items associated with domestic water supply. All associated work items, including pipes, fittings, valves, insulation, and hookup should be included in this assembly. The unit of measure at the assembly level is pieces of special equipment.</td>
<td>Automatic Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>02025310 1950</td>
<td>Valve, auto, above 4&quot;</td>
</tr>
<tr>
<td>0.202005</td>
<td>SPECIALTIES</td>
<td>Any other special items associated with domestic water supply. All associated work items, including pipes, fittings, valves, insulation, and hookup should be included in this assembly. The unit of measure at the assembly level is pieces of special equipment.</td>
<td>Auto Diaphragm Valve, above 4&quot; (&amp; not included in a system)</td>
<td>EA</td>
<td>02025310 2950</td>
<td>Valve, auto diaphragm, above 4&quot;</td>
</tr>
<tr>
<td>0.209004</td>
<td>POOL PIPING AND EQUIPMENT</td>
<td>Assemblies include pumps and associated equipment with pools, including specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Swimming Pool</td>
<td>GPM</td>
<td>F1045 1101 950</td>
<td>Swimming Pool</td>
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<tr>
<td>0.209005</td>
<td>COMPRESSED AIR SYSTEM (NON-</td>
<td>Compressed air system (non-breathing).</td>
<td>Air Compressor</td>
<td>PSI</td>
<td>03095110 1950</td>
<td>Air compressor, gas engine powered</td>
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<td>BREATHING)</td>
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<td></td>
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<td></td>
<td>PM</td>
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<tr>
<td>0.209005</td>
<td>COMPRESSED AIR SYSTEM (NON-</td>
<td>Compressed air system (non-breathing).</td>
<td>Air Compressor</td>
<td>PSI</td>
<td>03095114 1950</td>
<td>Air compressor, Centrifugal, 1 to 40 HP</td>
</tr>
<tr>
<td></td>
<td>BREATHING)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PM</td>
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<tr>
<td>0.209005</td>
<td>COMPRESSED AIR SYSTEM (NON-</td>
<td>Compressed air system (non-breathing).</td>
<td>Air Compressor</td>
<td>PSI</td>
<td>03095114 2950</td>
<td>Air compressor, Centrifugal, over 40 HP</td>
</tr>
<tr>
<td></td>
<td>BREATHING)</td>
<td></td>
<td></td>
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<td></td>
<td>PM</td>
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<tr>
<td>0.209005</td>
<td>COMPRESSED AIR SYSTEM (NON-</td>
<td>Compressed air system (non-breathing).</td>
<td>Air Compressor</td>
<td>PSI</td>
<td>03095118 1950</td>
<td>Air compressor, reciprocating, &lt; 5 HP</td>
</tr>
<tr>
<td></td>
<td>BREATHING)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PM</td>
</tr>
<tr>
<td>0.209005</td>
<td>COMPRESSED AIR SYSTEM (NON-</td>
<td>Compressed air system (non-breathing).</td>
<td>Air Compressor</td>
<td>PSI</td>
<td>03095118 2950</td>
<td>Air compressor, reciprocating, 5 to 40 HP</td>
</tr>
<tr>
<td></td>
<td>BREATHING)</td>
<td></td>
<td></td>
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<td>PM</td>
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<tr>
<td>0.209005</td>
<td>COMPRESSED AIR SYSTEM (NON-</td>
<td>Compressed air system (non-breathing).</td>
<td>Air Compressor</td>
<td>PSI</td>
<td>03095118 3950</td>
<td>Air compressor, reciprocating, &gt; 40 HP</td>
</tr>
</tbody>
</table>

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<tr>
<td>D.090005</td>
<td>COMPRESSED AIR SYSTEM (NON-BREATHING)</td>
<td>Compressed air system (non-breathing)</td>
<td>Air Dryer</td>
<td>PSI</td>
<td>Y NEED TO DEVELOP SAM JP</td>
<td>25</td>
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<tr>
<td>D.090099</td>
<td>OTHER SPECIAL PLUMBING SYSTEMS</td>
<td>This system includes special plumbing systems not described by the assembly categories listed above, such as fountain piping, systems, and devices</td>
<td>Duplex Sump</td>
<td>EA</td>
<td>D.0905905 1950</td>
<td>Pump, duplex submersible</td>
</tr>
<tr>
<td>D.090099</td>
<td>OTHER SPECIAL PLUMBING SYSTEMS</td>
<td>This system includes special plumbing systems not described by the assembly categories listed above, such as fountain piping, systems, and devices</td>
<td>Submersible Pump</td>
<td>EA</td>
<td>D.0905910 1950</td>
<td>Pump, submersible, 1 H.P. and over</td>
</tr>
<tr>
<td>D.090099</td>
<td>OTHER SPECIAL PLUMBING SYSTEMS</td>
<td>This system includes special plumbing systems not described by the assembly categories listed above, such as fountain piping, systems, and devices</td>
<td>Pump, Centrifugal, over 1 hp</td>
<td>EA</td>
<td>D.0905410 1950</td>
<td>Pump, Centrifugal, over 1 hp</td>
</tr>
<tr>
<td>D.090099</td>
<td>OTHER SPECIAL PLUMBING SYSTEMS</td>
<td>This system includes special plumbing systems not described by the assembly categories listed above, such as fountain piping, systems, and devices</td>
<td>Pump, Centrifugal, w/ reduction gear, over 1 hp</td>
<td>EA</td>
<td>D.0905410 2950</td>
<td>Pump, Centrifugal, w/ reduction gear, over 1 hp</td>
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<tr>
<td>D.090099</td>
<td>OTHER SPECIAL PLUMBING SYSTEMS</td>
<td>This system includes special plumbing systems not described by the assembly categories listed above, such as fountain piping, systems, and devices</td>
<td>Oxygen Monitor</td>
<td>EA</td>
<td>D.0905930 1950</td>
<td>Oxygen Monitor</td>
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<tr>
<td>D.301001</td>
<td>OTHER ENERGY SUPPLY</td>
<td>Energy supply not described by the assembly categories listed above</td>
<td>General</td>
<td>MBH</td>
<td>Y NEED TO DEVELOP SAM JP</td>
<td>20</td>
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<tr>
<td>D.302001</td>
<td>STEAM BOILERS</td>
<td>Assemblies include boilers, expansion tanks, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system</td>
<td>Oil/Gas/Comb., Steam - 500 to 1000 MBH</td>
<td>MBH</td>
<td>D.025140 3950</td>
<td>Boiler, steam, Oil/Gas/Comb., 500 to 1000 MBH</td>
</tr>
<tr>
<td>D.302001</td>
<td>STEAM BOILERS</td>
<td>Assemblies include boilers, expansion tanks, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system</td>
<td>Oil/Gas/Comb., Steam - 120 to 500 MBH</td>
<td>MBH</td>
<td>D.025140 2950</td>
<td>Boiler, steam, Oil/Gas/Comb., 120 to 500 MBH</td>
</tr>
</tbody>
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</tr>
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<tbody>
<tr>
<td>030201 STEAM BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system.</td>
<td>OIL/GAS/COMB., Steam - up to 120 MBH</td>
<td>MBH</td>
<td>D3025140 1950</td>
<td>Boiler, steam, OIL/GAS/COMB., up to 120 MBH</td>
<td>Y 1921-M 1920-Q 1919-A</td>
<td>M/Q/A</td>
<td>30</td>
</tr>
<tr>
<td>030201 STEAM BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system.</td>
<td>OIL/GAS/COMB., Steam - over 1000 MBH</td>
<td>MBH</td>
<td>D3025140 4950</td>
<td>Boiler, steam, OIL/GAS/COMB., over 1000 MBH</td>
<td>Y 1930-M 1929-Q 1928-A</td>
<td>M/Q/A</td>
<td>30</td>
</tr>
<tr>
<td>030201 STEAM BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system.</td>
<td>Electric, Steam</td>
<td>MBH</td>
<td>D3025110 1950</td>
<td>Boiler, electric, to 1500 gal.</td>
<td>Y 1905-Q 1905-A</td>
<td>Q</td>
<td>30</td>
</tr>
<tr>
<td>030202 HOT WATER BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system.</td>
<td>Electric, Hot Water</td>
<td>MBH</td>
<td>D3025110 1950</td>
<td>Boiler, electric, to 1500 gal.</td>
<td>Y 1905-Q 1905-A</td>
<td>Q</td>
<td>30</td>
</tr>
<tr>
<td>030202 HOT WATER BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system.</td>
<td>OIL/GAS/COMB., Hot Water - up to 120 MBH</td>
<td>MBH</td>
<td>D3025130 1950</td>
<td>Boiler, Hot Water, oil, gas, or combination fired, up to 120 MBH</td>
<td>Y 1908-M 1907-Q 1906-A</td>
<td>M/Q/A</td>
<td>30</td>
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<tr>
<td>030202 HOT WATER BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system.</td>
<td>OIL/GAS/COMB., Hot Water - 120 to 500 MBH</td>
<td>MBH</td>
<td>D3025130 2950</td>
<td>Boiler, Hot Water, oil, gas, or combination fired, 120 to 500 MBH</td>
<td>Y 1911-M 1910-Q 1909-A</td>
<td>M/Q/A</td>
<td>30</td>
</tr>
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**USCG Approved Equipment Enrollment Catalog - Existing SAM Maintained Equipment**

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<tbody>
<tr>
<td>030202</td>
<td>HOT WATER BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each.</td>
<td>Oil/Gas/Comb., Hot Water - 100 to 1000 MBH</td>
<td>MBH</td>
<td>Y</td>
<td>1914 - M 1913 - Q 1912 - A</td>
</tr>
<tr>
<td>030202</td>
<td>HOT WATER BOILERS</td>
<td>Assemblies include boilers, expansion tank, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each.</td>
<td>Oil/Gas/Comb. over 1000 MBH</td>
<td>MBH</td>
<td>Y</td>
<td>1918 - M 1917 - Q 1916 - A</td>
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<tr>
<td>030203</td>
<td>FURNACES</td>
<td>This is a system that heats air. Assemblies would include furnace and necessary fittings and specialties required for hookup, including flue and stack. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>Y</td>
<td>1944 - A</td>
</tr>
<tr>
<td>030203</td>
<td>FURNACES</td>
<td>This is a system that heats air. Assemblies would include furnace and necessary fittings and specialties required for hookup, including flue and stack. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>Y</td>
<td>2077 - A</td>
</tr>
<tr>
<td>030203</td>
<td>FURNACES</td>
<td>This is a system that heats air. Assemblies would include furnace and necessary fittings and specialties required for hookup, including flue and stack. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>Y</td>
<td>1943 - A</td>
</tr>
<tr>
<td>030203</td>
<td>FURNACES</td>
<td>This is a system that heats air. Assemblies would include furnace and necessary fittings and specialties required for hookup, including flue and stack. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>Y</td>
<td>1935 - Q 1934 - A</td>
</tr>
<tr>
<td>030203</td>
<td>FURNACES</td>
<td>This is a system that heats air. Assemblies would include furnace and necessary fittings and specialties required for hookup, including flue and stack. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>Y</td>
<td>1937 - Q 1936 - A</td>
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<tbody>
<tr>
<td>0.3020.03</td>
<td>FURNACES</td>
<td>This is a system that heats air. Assemblies would include furnace and necessary fittings and specialties required for hookup, including flue and stack. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>Unit Heater, Electric</td>
<td>Y</td>
<td>8486-A</td>
<td>A</td>
<td>25</td>
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<tr>
<td>0.3020.04</td>
<td>FUEL-FIRED UNIT HEATERS</td>
<td>Assemblies would include unit heaters and the energy supply system hookup (other than electrical), including all necessary pipe, fittings, and specialties required for hookup. Flue and stack, if required, are included in this assembly. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>D305.5110.2950</td>
<td>Y</td>
<td>1944-A</td>
<td>A</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>0.3020.04</td>
<td>FUEL-FIRED UNIT HEATERS</td>
<td>Assemblies would include unit heaters and the energy supply system hookup (other than electrical), including all necessary pipe, fittings, and specialties required for hookup. Flue and stack, if required, are included in this assembly. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>D305.5110.3950</td>
<td>Y</td>
<td>2077-A</td>
<td>A</td>
<td>25</td>
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<tr>
<td>0.3020.04</td>
<td>FUEL-FIRED UNIT HEATERS</td>
<td>Assemblies would include unit heaters and the energy supply system hookup (other than electrical), including all necessary pipe, fittings, and specialties required for hookup. Flue and stack, if required, are included in this assembly. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>D305.5110.1950</td>
<td>Y</td>
<td>1943-A</td>
<td>A</td>
<td>25</td>
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<tr>
<td>0.3020.04</td>
<td>FUEL-FIRED UNIT HEATERS</td>
<td>Assemblies would include unit heaters and the energy supply system hookup (other than electrical), including all necessary pipe, fittings, and specialties required for hookup. Flue and stack, if required, are included in this assembly. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>D305.5122.1990</td>
<td>Y</td>
<td>1935-Q</td>
<td>1934-A</td>
<td>25</td>
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<tr>
<td>0.3020.04</td>
<td>FUEL-FIRED UNIT HEATERS</td>
<td>Assemblies would include unit heaters and the energy supply system hookup (other than electrical), including all necessary pipe, fittings, and specialties required for hookup. Flue and stack, if required, are included in this assembly. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>D305.5122.2950</td>
<td>Y</td>
<td>1937-Q</td>
<td>1936-A</td>
<td>25</td>
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<th>Design Life</th>
</tr>
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<tr>
<td>D.302004</td>
<td>FUEL-FIRED UNIT HEATERS</td>
<td>Assemblies would include unit heaters and the energy supply system hookup (other than electrical), including all necessary pipe, fittings, and specialties required for hook-up. Flue and stack, if required, are included in this assembly. The unit of measure at the assembly level is each.</td>
<td>General</td>
<td>MBH</td>
<td>D30253101950</td>
<td>Pump, boiler fuel oil</td>
<td>Y</td>
<td>6486-A</td>
<td>A</td>
<td>25</td>
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<tr>
<td>D.302005</td>
<td>AUXILIARY EQUIPMENT</td>
<td>Boiler Feed Water Tank</td>
<td>MBH</td>
<td>D30252101950</td>
<td>Expansion/Compression/Deaerator Tank</td>
<td>Y</td>
<td>1931-S</td>
<td>S</td>
<td>30</td>
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<tr>
<td>D.302005</td>
<td>AUXILIARY EQUIPMENT</td>
<td>Expansion/Compression/Deaerator Tank</td>
<td>MBH</td>
<td>D30253101950</td>
<td>Expansion/Compression/Deaerator Tank</td>
<td>Y</td>
<td>1931-S</td>
<td>S</td>
<td>30</td>
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<tr>
<td>D.302005</td>
<td>AUXILIARY EQUIPMENT</td>
<td>Pump, boiler fuel oil</td>
<td>MBH</td>
<td>D30253101950</td>
<td>Pump, boiler fuel oil</td>
<td>Y</td>
<td>1939-S</td>
<td>S</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>D.302005</td>
<td>AUXILIARY EQUIPMENT</td>
<td>Pump, condensate return, over 1 hp</td>
<td>MBH</td>
<td>D30253102950</td>
<td>Pump, condensate return</td>
<td>Y</td>
<td>1940-S</td>
<td>S</td>
<td>25</td>
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<tr>
<td>D.302005</td>
<td>AUXILIARY EQUIPMENT</td>
<td>Pump, steam condensate return</td>
<td>MBH</td>
<td>D30253301950</td>
<td>Pump, steam condensate return</td>
<td>Y</td>
<td>1941-S</td>
<td>S</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>D.302005</td>
<td>AUXILIARY EQUIPMENT</td>
<td>Pump, Centrifugal, over 1 hp</td>
<td>EA</td>
<td>D30454101950</td>
<td>Pump, Centrifugal, over 1 hp</td>
<td>Y</td>
<td>1671-S</td>
<td>S</td>
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<tr>
<td>D.302009</td>
<td>OTHER HEAT GENERATING SYSTEMS</td>
<td>Heat generating systems not described in the Assembly categories listed</td>
<td>General</td>
<td>MBH</td>
<td>D30351302950</td>
<td>Chiller, Reciprocating, air cooled, over 25 Tons</td>
<td>Y</td>
<td>NEED TO DEVELOP SAM JP</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>D.303001</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Reciprocating</td>
<td>TON</td>
<td>D30351301950</td>
<td>Chiller, centrifugal, water cooled, up to 100 Tons</td>
<td>Y</td>
<td>2054-M</td>
<td>M/A</td>
<td>20</td>
</tr>
<tr>
<td>D.303001</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Centrifugal</td>
<td>TON</td>
<td>D30351401950</td>
<td>Chiller, centrifugal, water cooled, up to 100 Tons</td>
<td>Y</td>
<td>1802-W</td>
<td>W/M/S/A</td>
<td>20</td>
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</tbody>
</table>

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<tbody>
<tr>
<td>D.0300.01</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Cooling Tower</td>
<td>TON D.0305110.1950</td>
<td>Cooling tower, water, forced draft, up to 50 tons</td>
<td>Y 1799-S</td>
</tr>
<tr>
<td>D.0300.01</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Cooling Tower</td>
<td>TON D.0305110.2950</td>
<td>Cooling tower, water, forced draft, 50 to 500 tons</td>
<td>Y 1757-S</td>
</tr>
<tr>
<td>D.0300.01</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Screw</td>
<td>TON D.0305160.2950</td>
<td>Chiller, screw, water-cooled, over 100 tons</td>
<td>Y 1819-M</td>
</tr>
<tr>
<td>D.0300.01</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Reciprocating</td>
<td>TON D.0305130.1950</td>
<td>Chiller, reciprocating, air cooled, up to 25 Tons</td>
<td>Y 2048-M</td>
</tr>
<tr>
<td>D.0300.01</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Absorption</td>
<td>TON D.0305150.2950</td>
<td>Chiller, absorption unit, 500 to 5000 tons</td>
<td>Y 1797-Q</td>
</tr>
<tr>
<td>D.0300.01</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Reciprocating</td>
<td>TON D.0305135.1950</td>
<td>Chiller, reciprocating, water cooled, up to 50 Tons</td>
<td>Y 1808-M</td>
</tr>
<tr>
<td>D.0300.01</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Reciprocating</td>
<td>TON D.0305135.2950</td>
<td>Chiller, reciprocating, water cooled, over 50 Tons</td>
<td>Y 1811-M</td>
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<tr>
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<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Centrifugal</td>
<td>TON D.0305140.2950</td>
<td>Chiller, centrifugal water cooled, over 100 Tons</td>
<td>Y 2034-W</td>
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*Table depicts correlation/crosswalk between corresponding UNIFORMAT II Level 4, RS Means Facilities Maintenance and Repair Cost Data (FMRCD), and Coast Guard’s Shore Asset Management (SAM) equipment identification systems. Version 1.0*
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<th>Existing SAM Job Plan Numbers</th>
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<td>0.303001</td>
<td>CHILLED WATER SYSTEMS</td>
<td>Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.</td>
<td>Chiller, Absorption</td>
<td>TON</td>
<td>D30351501950</td>
<td>Chiller, absorption unit, up to 500 tons</td>
<td>Y</td>
<td>1793-Q 1793-A</td>
<td>Q/A</td>
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<tr>
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<td>CHILLED WATER SYSTEMS</td>
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<td>Chiller, Screw</td>
<td>TON</td>
<td>D30351601950</td>
<td>Chiller, screw, water cooled, up to 100 tons</td>
<td>Y</td>
<td>1814-M 1813-S 1812-A</td>
<td>M/S/A</td>
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<tr>
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<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Evaporative Cooler</td>
<td>TON</td>
<td>D30351801950</td>
<td>Evaporative cooler, rotating drum</td>
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<td>1818-A</td>
<td>A</td>
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<tr>
<td>0.303002</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Condenser, Air Cooled</td>
<td>TON</td>
<td>D30352203950</td>
<td>Condensing unit, air cooled, over 100 tons</td>
<td>Y</td>
<td>4511-Q 1698-A</td>
<td>Q/A</td>
<td>15</td>
</tr>
<tr>
<td>0.303002</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Condenser, Water Cooled</td>
<td>TON</td>
<td>D30352402950</td>
<td>Condensing unit, water cooled, 26 tons to 100 tons</td>
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<td>1708-Q 1703-A</td>
<td>Q/A</td>
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<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Condenser, Water Cooled</td>
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<td>D30352403950</td>
<td>Condensing unit, water cooled, over 100 tons</td>
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<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Condenser, Air Cooled</td>
<td>TON</td>
<td>D30352101950</td>
<td>Condenser, air cooled, 3 Tons to 25 Tons</td>
<td>Y</td>
<td>1779-Q 1776-A</td>
<td>Q/A</td>
<td>15</td>
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<tr>
<td>0.303002</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Condenser, Water Cooled</td>
<td>TON</td>
<td>D30352401950</td>
<td>Condensing unit, water cooled, 3 tons to 25 tons</td>
<td>Y</td>
<td>1713-Q 1710-A</td>
<td>Q/A</td>
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<tr>
<td>0.303002</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Condenser, Air Cooled</td>
<td>TON</td>
<td>D30352202950</td>
<td>Condensing unit, air cooled, 26 tons to 100 tons</td>
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<td>0.303002</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.</td>
<td>Condenser, Air Cooled</td>
<td>TON</td>
<td>D30352201950</td>
<td>Condensing unit, air cooled, 3 tons to 25 tons</td>
<td>Y</td>
<td>1826-Q 1825-A</td>
<td>Q/A</td>
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</tbody>
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<th>From U. S. Coast Guard SAM database</th>
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<tr>
<td>D.3030.02</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is TON.</td>
<td>Condenser, Air Cooled</td>
<td>TON</td>
<td>D3035210.3950</td>
<td>Condenser, air cooled, over 100 tons</td>
<td>Y</td>
<td>1694-Q</td>
</tr>
<tr>
<td>D.3030.02</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is TON.</td>
<td>Evaporative Cooler</td>
<td>TON</td>
<td>D3035170.1950</td>
<td>Evaporative cooler</td>
<td>Y</td>
<td>1810-A</td>
</tr>
<tr>
<td>D.3030.02</td>
<td>DIRECT EXPANSION SYSTEMS</td>
<td>Assemblies include condensers, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is TON.</td>
<td>Condenser, Air Cooled</td>
<td>TON</td>
<td>D3035210.2950</td>
<td>Condenser, air cooled, 26 tons to 100 tons</td>
<td>Y</td>
<td>9065-Q</td>
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<tr>
<td>D.3030.09</td>
<td>OTHER COOLING GENERATING SYSTEMS</td>
<td>Cooling generating systems not described by the assembly categories</td>
<td>Compressor, DX Refrigeration</td>
<td>TON</td>
<td>D3035260.1950</td>
<td>Compressor, DX refrigeration, to 25 tons</td>
<td>Y</td>
<td>1772-Q</td>
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<tr>
<td>D.3030.09</td>
<td>OTHER COOLING GENERATING SYSTEMS</td>
<td>Cooling generating systems not described by the assembly categories</td>
<td>Compressor, DX Refrigeration</td>
<td>TON</td>
<td>D3035260.2950</td>
<td>Compressor, DX refrigeration, to 25 to 100 tons</td>
<td>Y</td>
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<tr>
<td>D.3030.09</td>
<td>OTHER COOLING GENERATING SYSTEMS</td>
<td>Cooling generating systems not described by the assembly categories</td>
<td>Fluid cooler, 2 fans (no compressor)</td>
<td>TON</td>
<td>D3035290.1950</td>
<td>Fluid cooler, 2 fans (no compressor)</td>
<td>Y</td>
<td>1758-A</td>
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<tr>
<td>D.3030.09</td>
<td>OTHER COOLING GENERATING SYSTEMS</td>
<td>Pump, Centrifugal, over 1 hp</td>
<td>Pump, Centrifugal, over 1 hp</td>
<td>EA</td>
<td>D3045410.1950</td>
<td>Pump, Centrifugal, over 1 hp</td>
<td>Y</td>
<td>1671-S</td>
</tr>
<tr>
<td>D.3040.01</td>
<td>AIR DISTRIBUTION, HEATING AND COOLING</td>
<td>Assemblies include heating coils, cooling coils, and fittings and specialties required for water hook-up. This assembly also includes duct heaters, filters, humidifiers, supply and return ductwork, dampers, fire dampers, supply and return grilles, registers and diffusers, turning vanes, sound traps, and all associated insulation. The unit of measure at the assembly level is CF/M.</td>
<td>Air Filters, Electrostatic</td>
<td>CF/M</td>
<td>D3045150.1950</td>
<td>Air Filters, Electrostatic</td>
<td>Y</td>
<td>9316-Q</td>
</tr>
<tr>
<td>D.3040.01</td>
<td>AIR DISTRIBUTION, HEATING AND COOLING</td>
<td>Assemblies include heating coils, cooling coils, and fittings and specialties required for water hook-up. This assembly also includes duct heaters, filters, humidifiers, supply and return ductwork, dampers, fire dampers, supply and return grilles, registers and diffusers, turning vanes, sound traps, and all associated insulation. The unit of measure at the assembly level is CF/M.</td>
<td>Variable Air Volume Box</td>
<td>CF/M</td>
<td>D3045160.1950</td>
<td>Variable Air Volume Box</td>
<td>Y</td>
<td>1788-S</td>
</tr>
</tbody>
</table>

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**UNIFORMAT II Level 4 Definition**

**Component Type**
- Fire Dampers
- Fan, centrifugal, 3,000 to 10,000 CFM
- Fan, axial, up to 5,000 CFM
- Fan, centrifugal, up to 5,000 CFM
- Fan, axial, up to 5,000 CFM
- Fan, centrifugal, over 10,000 CFM
- Fan, axial, over 10,000 CFM
- Fan, centrifugal, up to 25,000 CFM
- Fan, axial, up to 25,000 CFM
- Fan, centrifugal, over 25,000 CFM
- Fan, axial, over 25,000 CFM
- Axial
- Centrifugal

**Equipment Type**
- Exhaust Systems
- System, Roof Exhaust
- Fans
- System, Wall Exhaust

**Material/Equipment Category**

<table>
<thead>
<tr>
<th>Material/Equipment Category</th>
<th>UNIFORMAT II Level 4 Definition</th>
<th>Component Type</th>
<th>Material/Equipment Category</th>
<th>UNIFORMAT II Level 4 Definition</th>
<th>Component Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEATING</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fire Dampers</td>
<td>HEATING</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fire Dampers</td>
</tr>
<tr>
<td>COOLING</td>
<td>Humidifiers, dampers, ductwork, grilles, registers, turning vanes, sound and insulation. The unit of measure at the assembly level is measure.</td>
<td>Fan, centrifugal, 3,000 to 10,000 CFM</td>
<td>COOLING</td>
<td>Humidifiers, dampers, ductwork, grilles, registers, turning vanes, sound and insulation. The unit of measure at the assembly level is measure.</td>
<td>Fan, axial, up to 5,000 CFM</td>
</tr>
<tr>
<td>SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fan, centrifugal, over 10,000 CFM</td>
<td>SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fan, axial, over 10,000 CFM</td>
</tr>
<tr>
<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fan, centrifugal, up to 25,000 CFM</td>
<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fan, axial, up to 25,000 CFM</td>
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<tr>
<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fan, centrifugal, over 25,000 CFM</td>
<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Fan, axial, over 25,000 CFM</td>
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<td>EXHAUST SYSTEMS</td>
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<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
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<td>EXHAUST SYSTEMS</td>
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<td>Centrifugal</td>
<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
<td>Axial</td>
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<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
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<td>EXHAUST SYSTEMS</td>
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<td>Assemblies include ductwork, grilles, registers, and all associated work. The unit of measure at the assembly level is CFM.</td>
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<td>EXHAUST SYSTEMS</td>
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<td>D.304007</td>
<td>EXHAUST SYSTEMS</td>
<td>Assemblies include ductwork grilles, registers, diffusers, fans, and all associated work. The unit of measure at the assembly level is each system.</td>
<td>Fan System, Wall Exhaust, Centrifugal</td>
<td>CF/M</td>
<td>030452201950 Fan, centrifugal, up to 5,000 CFM</td>
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<td>AIR HANDLING UNITS</td>
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<td>Air Handling Unit</td>
<td>CF/M</td>
<td>030451101950 Air Handling Unit, 3 thru 24 Tons</td>
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<td>AIR HANDLING UNITS</td>
<td>Air handling units.</td>
<td>Air Handling Unit</td>
<td>CF/M</td>
<td>030451102950 Air Handling Unit, 25 Thru 50 Tons</td>
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<td>Air handling units.</td>
<td>Air Handling Unit</td>
<td>CF/M</td>
<td>030451103950 Air Handling Unit, over 50 Tons</td>
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<tr>
<td>D.304008</td>
<td>AIR HANDLING UNITS</td>
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<td>Air Handling Unit - Computer RM</td>
<td>CF/M</td>
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<td>MBH</td>
<td>030456001950 Heat exchanger, steam</td>
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<td>UNIT HEATERS</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
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<td>EA</td>
<td>030551102950 Unit heater, gas infrared</td>
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<td>EA</td>
<td>030551103950 Space Heater, unit heater, steam</td>
</tr>
<tr>
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<td>UNIT HEATERS</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
<td>Gas Radiant</td>
<td>EA</td>
<td>030551101950 Unit heater, gas radiant</td>
</tr>
<tr>
<td>D.305002</td>
<td>UNIT HEATERS</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
<td>Gas Radiant</td>
<td>EA</td>
<td>030551221950 Forced Air Heater, Unit Heater, oil or gas fired up to 120 MBH</td>
</tr>
<tr>
<td>D.305002</td>
<td>UNIT HEATERS</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
<td>Gas Radiant</td>
<td>EA</td>
<td>030551222950 Forced Air Heater, Unit Heater, oil or gas fired over 120 MBH</td>
</tr>
<tr>
<td>D.305002</td>
<td>UNIT HEATERS</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
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<td>EA</td>
<td>030551222950 Unit Heater, Electric</td>
</tr>
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<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
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<td>EA</td>
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<td>D.305004</td>
<td>FIN TUBE RADIATION</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
<td>Fin Tube Radiation, Electric</td>
<td>EA</td>
<td>030451202950 Fin Tube Radiation</td>
</tr>
<tr>
<td>D.305004</td>
<td>FIN TUBE RADIATION</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
<td>Fin Tube Radiation, Hot Water</td>
<td>EA</td>
<td>030551103950 Unit heater, steam/hot water</td>
</tr>
<tr>
<td>D.305005</td>
<td>ELECTRIC HEATING</td>
<td>Assemblies include the complete terminal unit and wall sleeve with all controls.</td>
<td>Electric Heating</td>
<td>EA</td>
<td>Electric Heating</td>
</tr>
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<td>D.305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Heat Pump, Air Cooled</td>
<td>EA D30553102950</td>
<td>Heat Pump, air cooled over 5 Tons</td>
<td>Y 1949-Q</td>
<td>1948-A</td>
<td>Q/A 20</td>
</tr>
<tr>
<td>D.305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Heat Pump, Water Cooled</td>
<td>EA D30553202950</td>
<td>Heat pump, water cooled, over 5 ton</td>
<td>Y 1953-Q</td>
<td>1952-A</td>
<td>Q/A 20</td>
</tr>
<tr>
<td>D.305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Split System A/C, Air Cooled, Elec. Heat - 10 ton</td>
<td>EA D30552502950</td>
<td>Air Conditioning, split system, air cooled over 10 Tons</td>
<td>Y 1725-Q</td>
<td>1729-A</td>
<td>Q/A 20</td>
</tr>
<tr>
<td>D.305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Packaged A/C, Air Cooled</td>
<td>EA D30552102950</td>
<td>Packaged Unit, air cooled, 25 thru 50 Tons</td>
<td>Y 1957-Q</td>
<td>1956-A</td>
<td>Q/A 20</td>
</tr>
<tr>
<td>D.305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Packaged A/C Water Cooled</td>
<td>EA D30552201950</td>
<td>Package unit, water cooled, 3 thru 2.4 ton</td>
<td>Y 1959-Q</td>
<td>1958-A</td>
<td>Q/A 20</td>
</tr>
<tr>
<td>D.305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Packaged A/C Water Cooled</td>
<td>EA D30552202950</td>
<td>Package unit, water cooled, 25 thru 50 ton</td>
<td>Y 1961-Q</td>
<td>1960-A</td>
<td>Q/A 20</td>
</tr>
</tbody>
</table>

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<td>UNIFORMAT II Level 4</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Heat Pump, Air Cooled</td>
<td>EA</td>
<td>D305 53601 1950</td>
<td>Heat Pump, Air cooled up to 5 Tons</td>
</tr>
<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Heat Pump, Water Cooled</td>
<td>EA</td>
<td>D305 53202 1950</td>
<td>Heat pump, water cooled up to 5 ton</td>
</tr>
<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Split System A/C, Air Cooled, Elec. Heat</td>
<td>EA</td>
<td>D305 52501 1950</td>
<td>Air Conditioning, split system, air cooled up to 50 Tons</td>
</tr>
<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>A/C Unit, Computer Room</td>
<td>EA</td>
<td>D305 52301 1950</td>
<td>Package unit, computer room</td>
</tr>
<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Package A/C</td>
<td>EA</td>
<td>D305 52401 1950</td>
<td>Package unit with duct gas heater</td>
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<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Forced Air Heater</td>
<td>EA</td>
<td>D305 51221 1950</td>
<td>Heater, Forced Air, oil/gas, up to 120 MBH</td>
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</tbody>
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<th>Design Life</th>
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<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Forced Air Heater</td>
<td>EA</td>
<td>D30552101950</td>
<td>Packaged Unit, air cooled, 3 thru 24 Tons</td>
<td>Y</td>
<td>1955-Q 1954-A</td>
<td>Q/A</td>
<td>20</td>
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<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Packaged A/C Air Cooled</td>
<td>EA</td>
<td>D30552101950</td>
<td>Split System, Water Cooled up to 10 Tons</td>
<td>Y</td>
<td>9325-Q 9319-A</td>
<td>Q/A</td>
<td>20</td>
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<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Split System, Water Cooled</td>
<td>EA</td>
<td>D30552101950</td>
<td>Split System, Water Cooled - over 10 Tons</td>
<td>Y</td>
<td>9326-Q 9320-A</td>
<td>Q/A</td>
<td>20</td>
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<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Split System, Heat Pump, Air Cooled</td>
<td>EA</td>
<td>D30552101950</td>
<td>Split System, Heat Pump, Air Cooled up to 5 Tons</td>
<td>Y</td>
<td>9327-Q 9321-A</td>
<td>Q/A</td>
<td>20</td>
</tr>
<tr>
<td>D305006</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Split System, Heat Pump, Air Cooled</td>
<td>EA</td>
<td>D30552101950</td>
<td>Split System, Heat Pump, Air Cooled over 5 Tons</td>
<td>Y</td>
<td>9328-Q 9322-A</td>
<td>Q/A</td>
<td>20</td>
</tr>
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<tr>
<td>D.0050.06</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Split System, Heat Pump, Water Cooled</td>
<td>EA</td>
<td>Split System, Heat Pump, Water Cooled up to 5 Tons</td>
<td>Y 9329-Q 9323-A  Q/A  20</td>
</tr>
<tr>
<td>D.0050.06</td>
<td>PACKAGE UNITS</td>
<td>Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each.</td>
<td>Split System, Heat Pump, Water Cooled</td>
<td>EA</td>
<td>Split System, Heat Pump, Water Cooled Over 5 Tons</td>
<td>Y 9330-Q 9324-A  Q/A  20</td>
</tr>
<tr>
<td>D.0050.09</td>
<td>OTHER TERMINAL AND PACKAGE UNITS</td>
<td>Terminal and package units not described by the assembly categories listed above.</td>
<td>General</td>
<td>MBH</td>
<td>Y NEED TO DEVELOP SAM JP</td>
<td>25</td>
</tr>
<tr>
<td>D.0060.01</td>
<td>HVAC CONTROLS</td>
<td>Includes devices such as thermostats, timers, sensors, control valves, etc., necessary to operate the total system. The unit of measure at the assembly level is each system.</td>
<td>Controls, central system, electro/pneumatic</td>
<td>EA</td>
<td>Controls, central system, electro/pneumatic</td>
<td>Y 1728-A  A  20</td>
</tr>
<tr>
<td>D.0060.02</td>
<td>ELECTRONIC CONTROLS</td>
<td>Electronic controls.</td>
<td>Controls, central system, electro/pneumatic</td>
<td>EA</td>
<td>Controls, central system, electro/pneumatic</td>
<td>Y 1728-A  A  15</td>
</tr>
<tr>
<td>D.0060.03</td>
<td>PNEUMATIC CONTROLS</td>
<td>Assemblies includes ball and butterfly valves, actuators, high pressure chokes, valve positioners, sensors, regulators, etc.</td>
<td>Controls, central system, electro/pneumatic</td>
<td>EA</td>
<td>Controls, central system, electro/pneumatic</td>
<td>Y 1728-A  A  15</td>
</tr>
<tr>
<td>D.0060.04</td>
<td>INSTRUMENT AIR COMPRESSORS</td>
<td>Assemblies include air compressors, dryers, and distribution tubing, (only used with pneumatic control systems). The unit of measure at the assembly level is each.</td>
<td>Air Compressor</td>
<td>EA</td>
<td>Air compressor, gas engine powered</td>
<td>Y 1737-M 1731-S  M/S  25</td>
</tr>
<tr>
<td>D.0060.04</td>
<td>INSTRUMENT AIR COMPRESSORS</td>
<td>Assemblies include air compressors, dryers, and distribution tubing, (only used with pneumatic control systems). The unit of measure at the assembly level is each.</td>
<td>Air Compressor</td>
<td>EA</td>
<td>Air compressor, Centrifugal, to 40 HP</td>
<td>Y 1740-Q  Q  25</td>
</tr>
<tr>
<td>D.0060.04</td>
<td>INSTRUMENT AIR COMPRESSORS</td>
<td>Assemblies include air compressors, dryers, and distribution tubing, (only used with pneumatic control systems). The unit of measure at the assembly level is each.</td>
<td>Air Compressor</td>
<td>EA</td>
<td>Air compressor, Centrifugal, over 40 HP</td>
<td>Y 1754-M 1751-S 1744-A  M/S/A  25</td>
</tr>
<tr>
<td>D.0060.04</td>
<td>INSTRUMENT AIR COMPRESSORS</td>
<td>Assemblies include air compressors, dryers, and distribution tubing, (only used with pneumatic control systems). The unit of measure at the assembly level is each.</td>
<td>Air Compressor</td>
<td>EA</td>
<td>Air compressor, reciprocating, &lt; 5 HP</td>
<td>Y 1756-Q  Q  25</td>
</tr>
</tbody>
</table>

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<th>Component Type</th>
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<tr>
<td>0.3060.04</td>
<td>INSTRUMENT AIR COMPRESSORS</td>
<td>Assemblies include air compressors, dryers, and distribution tubing, (only used with pneumatic control systems). The unit of measure at the assembly level is each.</td>
<td>Air Compressor</td>
<td>EA</td>
<td>D30951182950 Air compressor, reciprocating, 5 to 40 HP</td>
<td>Y 1761-Q QL 25</td>
</tr>
<tr>
<td>0.3060.04</td>
<td>INSTRUMENT AIR COMPRESSORS</td>
<td>Assemblies include air compressors, dryers, and distribution tubing, (only used with pneumatic control systems). The unit of measure at the assembly level is each.</td>
<td>Air Compressor</td>
<td>EA</td>
<td>D30951183950 Air compressor, reciprocating, &gt; 40 HP</td>
<td>Y 1766-Q QL 25</td>
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<tr>
<td>0.3060.99</td>
<td>OTHER CONTROLS INSTRUMENTATION</td>
<td>Controls and instrumentation not described by the assembly categories listed above.</td>
<td>General</td>
<td>MBH</td>
<td></td>
<td>Y NEED TO DEVELOP SAM JP 20</td>
</tr>
<tr>
<td>0.3090.99</td>
<td>OTHER SPECIAL MECHANICAL SYSTEMS</td>
<td>Any other mechanical system not defined in other categories. Assemblies would include special systems and special devices. The unit of measure at the assembly level is each system or device.</td>
<td>Humidification System</td>
<td>EA</td>
<td>D30952101950 Steam humidification system</td>
<td>Y 1769-S S 10</td>
</tr>
<tr>
<td>0.3090.99</td>
<td>OTHER SPECIAL MECHANICAL SYSTEMS</td>
<td>Any other mechanical system not defined in other categories. Assemblies would include special systems and special devices. The unit of measure at the assembly level is each system or device.</td>
<td>Evaporative Pan</td>
<td>EA</td>
<td>D30952102950 Evaporative Pan w/Heating Coil</td>
<td>Y 1773-S S 10</td>
</tr>
<tr>
<td>0.3090.99</td>
<td>OTHER SPECIAL MECHANICAL SYSTEMS</td>
<td>Any other mechanical system not defined in other categories. Assemblies would include special systems and special devices. The unit of measure at the assembly level is each system or device.</td>
<td>Dehumidifier</td>
<td>EA</td>
<td>D30952201950 Dehumidifier, desiccant wheel</td>
<td>Y 1807-M 1795-S M/S 10</td>
</tr>
<tr>
<td>0.3090.99</td>
<td>OTHER SPECIAL MECHANICAL SYSTEMS</td>
<td>Any other mechanical system not defined in other categories. Assemblies would include special systems and special devices. The unit of measure at the assembly level is each system or device.</td>
<td>Air Curtain</td>
<td>EA</td>
<td></td>
<td>Y NEED TO DEVELOP SAM JP 10</td>
</tr>
<tr>
<td>0.3090.99</td>
<td>OTHER SPECIAL MECHANICAL SYSTEMS</td>
<td>Shop Vacuum System</td>
<td>Dust Collector</td>
<td>EA</td>
<td></td>
<td>Y 4617-M M 30</td>
</tr>
<tr>
<td>0.4010.01</td>
<td>SPRINKLER RS AND RELEASING DEVICES</td>
<td>The fixture, device, or sprinkler head that releases the water to suppress the fire. The unit of measure at the assembly level is each sprinkler head.</td>
<td>Dry Pipe Systems</td>
<td>EA</td>
<td>D40153101950 Extinguishing system, dry pipe</td>
<td>Y 1888-M 1887-Q 1886-A M/Q/A 30</td>
</tr>
<tr>
<td>0.4010.01</td>
<td>SPRINKLER RS AND RELEASING DEVICES</td>
<td>The fixture, device, or sprinkler head that releases the water to suppress the fire. The unit of measure at the assembly level is each sprinkler head.</td>
<td>Deluge Systems</td>
<td>EA</td>
<td>D40153801950 Extinguishing system, deluge / pre-action</td>
<td>Y 1878-M 1877-Q 1875-A M/Q/A 30</td>
</tr>
</tbody>
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### USCG Approved Equipment Enrollment Catalog -
Existing SAM Maintained Equipment*

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<td>D040101</td>
<td>SPRINKLER RS AND RELEASING DEVICES</td>
<td>The fixture, device, or sprinkler head that releases the water to suppress the fire. The unit of measure at the assembly level is each sprinkler head.</td>
<td>Wet Pipe Systems</td>
<td>EA</td>
<td>D0415130 1950 Extinguishing system, wet pipe</td>
<td>Y 1891-M 1890-Q 1889-A M/Q/A 30</td>
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<tr>
<td>D040102</td>
<td>SPRINKLER WATER SUPPLY EQUIPMENT AND PIPING</td>
<td>Assemblies include alarm valves, flow control valves, pipe and fittings from equipment to sprinkler heads, including all supports and wall or floor sleeves. All equipment including tanks, pumps, and other associated equipment, fittings, and specialties required for hook-up are in this assembly. The unit of measure at the assembly level is each sprinkler head.</td>
<td>Included with Dry Pipe, Deluge, &amp; Wet Pipe Systems</td>
<td>EA</td>
<td>D0415310 1950 Extinguishing system, dry pipe</td>
<td>Y 1888-M 1887-Q 1886-A M/Q/A 25</td>
</tr>
<tr>
<td>D040102</td>
<td>SPRINKLER WATER SUPPLY EQUIPMENT AND PIPING</td>
<td>Assemblies include alarm valves, flow control valves, pipe and fittings from equipment to sprinkler heads, including all supports and wall or floor sleeves. All equipment including tanks, pumps, and other associated equipment, fittings, and specialties required for hook-up are in this assembly. The unit of measure at the assembly level is each sprinkler head.</td>
<td>Included with Dry Pipe, Deluge, &amp; Wet Pipe Systems</td>
<td>EA</td>
<td>D0415180 1950 Extinguishing system, deluge/pre-action</td>
<td>Y 1878-M 1877-Q 1875-A M/Q/A 25</td>
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<tr>
<td>D040102</td>
<td>SPRINKLER WATER SUPPLY EQUIPMENT AND PIPING</td>
<td>Assemblies include alarm valves, flow control valves, pipe and fittings from equipment to sprinkler heads, including all supports and wall or floor sleeves. All equipment including tanks, pumps, and other associated equipment, fittings, and specialties required for hook-up are in this assembly. The unit of measure at the assembly level is each sprinkler head.</td>
<td>Included with Dry Pipe, Deluge, &amp; Wet Pipe Systems</td>
<td>EA</td>
<td>D0415150 1950 Extinguishing system, wet pipe</td>
<td>Y 1891-M 1890-Q 1889-A M/Q/A 25</td>
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<tr>
<td>D040201</td>
<td>STANDBY PIPE EQUIPMENT AND PIPING</td>
<td>Assemblies include standpipe risers and all other piping, fittings, and supports associated with this category. Siamese connections, roof manifolds, cabinets, hoses, racks, and other fire department connections are included in this assembly. All equipment including pumps, tanks, etc., with all required fittings and specialties for hook-up are included in the assembly.</td>
<td>Backflow Preventer, up to 4&quot; (typically included as part of wet pipe system)</td>
<td>EA</td>
<td>D0415100 1950 Backflow prevention device, up to 4&quot;</td>
<td>Y 1972-A A 20</td>
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<td>D402001</td>
<td>STANDPIPE EQUIPMENT AND PIPING</td>
<td>Assemblies include standpipe risers and all other piping, fittings, and supports associated with this category. Siamese connections, roof manifolds, cabinets, hoses, racks, and other fire department connections are included in this assembly. All equipment including pumps, tanks, etc., with all required fittings and specialties for hook-up are included in this assembly.</td>
<td>Backflow Preventer, over 4&quot; (typically included as part of wet pipe system)</td>
<td>EA</td>
<td>D4015100.2950</td>
<td>Backflow prevention device, over 4&quot;</td>
</tr>
<tr>
<td>D402001</td>
<td>STANDPIPE EQUIPMENT AND PIPING</td>
<td>Assemblies include standpipe risers and all other piping, fittings, and supports associated with this category. Siamese connections, roof manifolds, cabinets, hoses, racks, and other fire department connections are included in this assembly. All equipment including pumps, tanks, etc., with all required fittings and specialties for hook-up are included in this assembly.</td>
<td>Fire Pump, Electric Motor</td>
<td>EA</td>
<td>D4015210.1950</td>
<td>Fire Pump, electric motor driven</td>
</tr>
<tr>
<td>D402001</td>
<td>STANDPIPE EQUIPMENT AND PIPING</td>
<td>Assemblies include standpipe risers and all other piping, fittings, and supports associated with this category. Siamese connections, roof manifolds, cabinets, hoses, racks, and other fire department connections are included in this assembly. All equipment including pumps, tanks, etc., with all required fittings and specialties for hook-up are included in this assembly.</td>
<td>Fire Pump, Motor/Engine</td>
<td>EA</td>
<td>D4015250.1950</td>
<td>Fire pump, motor/engine driven</td>
</tr>
<tr>
<td>D403001</td>
<td>FIRE EXTINGUISHING DEVICES</td>
<td>Assemblies include all types of fire extinguishers, that is, water, dry chemical, carbon dioxide, soda acid, etc. The brackets, sleeves, and supporting devices are included in this assembly.</td>
<td>Fire Extinguishers</td>
<td>EA</td>
<td>D4095100.1950</td>
<td>Fire Extinguishers</td>
</tr>
<tr>
<td>D409001</td>
<td>CARBON DIOXIDE SYSTEMS</td>
<td>Carbon dioxide systems.</td>
<td>Extinguishing system, CO2</td>
<td>EA</td>
<td>D4095100.1950</td>
<td>Extinguishing system, CO2</td>
</tr>
<tr>
<td>D409002</td>
<td>FOAM GENERATING EQUIPMENT</td>
<td>Foam generating equipment.</td>
<td>Bottle</td>
<td>EA</td>
<td>D4095200.1950</td>
<td>Extinguishing system, foam bottle</td>
</tr>
<tr>
<td>D409002</td>
<td>FOAM GENERATING EQUIPMENT</td>
<td>Foam generating equipment.</td>
<td>Electric</td>
<td>EA</td>
<td>D4095210.1950</td>
<td>Extinguishing system, foam, electric</td>
</tr>
<tr>
<td>D409002</td>
<td>FOAM GENERATING EQUIPMENT</td>
<td>Foam generating equipment.</td>
<td>Diesel</td>
<td>EA</td>
<td>D4095220.1950</td>
<td>Extinguishing system, foam, diesel</td>
</tr>
<tr>
<td>D409003</td>
<td>CLEAN AGENT SYSTEMS</td>
<td>Clean agent systems.</td>
<td>Extinguishing system, dry chemical</td>
<td>EA</td>
<td>D4095400.1950</td>
<td>Extinguishing system, dry chemical</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Material/Equipment Category</th>
<th>Uniformat II (see ASTM E1557) Level 4 Definition</th>
<th>Component Type</th>
<th>UOM</th>
<th>From US Coast Guard SAM Maintenance and Repair Cost Data (FMRCD), Data Systems, North American United States, 2019</th>
<th>From RS MEANS FMRCD Manual</th>
<th>From U. S. Coast Guard SAM database</th>
</tr>
</thead>
<tbody>
<tr>
<td>D400005</td>
<td>HOOD AND DUCT FIRE PROTECTION</td>
<td>Hood and duct fire protection.</td>
<td>Extinguishing</td>
<td>EA</td>
<td>D4095450 1950 Extinguishing system, FM200</td>
<td>Y 1885-M 1884-S 1883 A</td>
<td>M/S/A 25</td>
</tr>
<tr>
<td>D409099</td>
<td>OTHER SPECIAL FIRE PROTECTION SYSTEMS</td>
<td>Assemblies includes other fire protection systems such as halon systems, exhaust hood systems, and special chemical suppression systems</td>
<td>General</td>
<td>EA</td>
<td>D5015240 1950 Transformer, dry type 500 KVA and over</td>
<td>Y NEED TO DEVELOP SAM JP</td>
<td>A 20</td>
</tr>
<tr>
<td>D501001</td>
<td>MAIN TRANSFORMERS</td>
<td>Overhead or underground transformers used for primary electrical service. Assemblies include transformers, Pad, trenching, and backfill.</td>
<td>Dry Type</td>
<td>KVA</td>
<td>D505240 1950 Transformer, oil, pad mounted</td>
<td>Y 2024-A</td>
<td>A 30</td>
</tr>
<tr>
<td>D501001</td>
<td>MAIN TRANSFORMERS</td>
<td>Overhead or underground transformers used for primary electrical service. Assemblies include transformers, Pad, trenching, and backfill.</td>
<td>Pad Mount, oil</td>
<td>KVA</td>
<td>D505240 2950 Transformer, dry type 500 KVA and over</td>
<td>Y 2025-A</td>
<td>A 30</td>
</tr>
<tr>
<td>D501002</td>
<td>SECONDARY</td>
<td>Transformers fed from protection equipment on the building side of primary transformer. Assemblies include transformers, conduit, conduit support, and wire.</td>
<td>Dry Type</td>
<td>KVA</td>
<td>D505240 1950 Transformer, dry type 500 KVA and over</td>
<td>Y 2024-A</td>
<td>A 30</td>
</tr>
<tr>
<td>D501002</td>
<td>SECONDARY</td>
<td>Transformers fed from protection equipment on the building side of primary transformer. Assemblies include transformers, Pad, conduit, and conduit support, and wire.</td>
<td>Pad Mount, oil</td>
<td>KVA</td>
<td>D505240 2950 Transformer, oil, pad mounted</td>
<td>Y 2025-A</td>
<td>A 30</td>
</tr>
<tr>
<td>D501003</td>
<td>MAIN SWITCHBOARDS</td>
<td>This includes the protection equipment and metering devices for main distribution. Assemblies include main distribution panel, breaker, fuses, and meters.</td>
<td>Switchboard, w/air circuit breaker</td>
<td>KVA</td>
<td>D505214 1950 Switchboard, w/air circuit breaker</td>
<td>Y 2016-M 2015-A</td>
<td>M/A 25</td>
</tr>
<tr>
<td>D501003</td>
<td>MAIN SWITCHBOARDS</td>
<td>This includes the protection equipment and metering devices for main distribution. Assemblies include main distribution panel, breaker, fuses, and meters.</td>
<td>Switchboard</td>
<td>KVA</td>
<td>D505210 1950 Switchboard</td>
<td>Y 2014-A</td>
<td>A 25</td>
</tr>
<tr>
<td>D501003</td>
<td>MAIN SWITCHBOARDS</td>
<td>This includes the protection equipment and metering devices for main distribution. Assemblies include main distribution panel, breaker, fuses, and meters.</td>
<td>Switchboard, w/air circuit breaker and tie switch</td>
<td>KVA</td>
<td>D505217 1950 Switchboard, w/air circuit breaker and tie switch</td>
<td>Y 2018-M 2017-A</td>
<td>M/A 25</td>
</tr>
<tr>
<td>D501004</td>
<td>INTERIOR DISTRIBUTION TRANSFORMERS</td>
<td>This includes the interior step-down or back boost transformers.</td>
<td>Dry Type</td>
<td>KVA</td>
<td>D505240 1950 Transformer, dry type 500 KVA and over</td>
<td>Y 2024-A</td>
<td>A 30</td>
</tr>
<tr>
<td>D501004</td>
<td>INTERIOR DISTRIBUTION TRANSFORMERS</td>
<td>This includes the interior step-down or back boost transformers.</td>
<td>Pad Mount, oil</td>
<td>KVA</td>
<td>D505240 2950 Transformer, oil, pad mounted</td>
<td>Y 2025-A</td>
<td>A 30</td>
</tr>
<tr>
<td>D501005</td>
<td>PANELS</td>
<td>Branch circuit panelboards. Assemblies include panelboards, Pad, breakers, conduit, and wire.</td>
<td>Panel board</td>
<td>AMP</td>
<td>D505200 1950 Panel board</td>
<td>Y 2029-A</td>
<td>A 25</td>
</tr>
<tr>
<td>D501006</td>
<td>ENCLOSED CIRCUIT BREAKERS</td>
<td>Over-current protection device enclosed in its own housing. Assemblies include enclosed circuit breaker, conduit, and wire.</td>
<td>Circuit Breaker, HV Air</td>
<td>AMP</td>
<td>D505210 1950 Circuit Breaker, HV air</td>
<td>Y 2012-A</td>
<td>A 25</td>
</tr>
</tbody>
</table>

*Table depicts correlation/crosswalk between corresponding UNIFORMAT II Level 4, RS Means Facilities Maintenance and Repair Cost (FMRCD), and Coast Guard's Shore Asset Management (SAM) equipment identification systems. Version 1.0
<table>
<thead>
<tr>
<th>Component Type</th>
<th>Material/Equipment Category</th>
<th>UNSM Level</th>
<th>Life</th>
<th>Description</th>
<th>Usage</th>
<th>Cost Basis</th>
<th>FMRCD 11.4.3</th>
<th>USCG 11.4.3</th>
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<tbody>
<tr>
<td>SHORAN II UMTS</td>
<td>UNIFORMAT (Level I)</td>
<td>Level 1</td>
<td>500</td>
<td>SHORAN II UMTS</td>
<td>500</td>
<td>500</td>
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<td></td>
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<tr>
<td></td>
<td>UNIFORMAT (Level II)</td>
<td>Level 2</td>
<td>100</td>
<td>SHORAN II UMTS</td>
<td>100</td>
<td>100</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>UNIFORMAT (Level III)</td>
<td>Level 3</td>
<td>50</td>
<td>SHORAN II UMTS</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>UNIFORMAT (Level IV)</td>
<td>Level 4</td>
<td>25</td>
<td>SHORAN II UMTS</td>
<td>25</td>
<td>25</td>
<td></td>
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</tbody>
</table>

**Table Note:**
- Level 4: SHORAN II UMTS
- Level 3: SHORAN II UMTS
- Level 2: SHORAN II UMTS
- Level 1: SHORAN II UMTS

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<tr>
<th>Uniformat II Level 4</th>
<th>Material/Equipment Category</th>
<th>Level 4 Definition</th>
<th>Component Type</th>
<th>UOM</th>
<th>From RS MEANS FMRCO Manual</th>
<th>From U. S. Coast Guard SAM database</th>
</tr>
</thead>
<tbody>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>AC/DC Inverter, Aircraft</td>
<td>SF</td>
<td>D5095210 1950 Emergency Generator, up to 15 KVA</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Emergency lighting</td>
<td>SF</td>
<td>D5095250 1950 Light, emergency, hard wired</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Uninterruptible Power Supply</td>
<td>SF</td>
<td>D5095230 1950 Uninterruptible power system, up to 200KVA</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Power Stabilizer</td>
<td>SF</td>
<td>D5095220 1950 Power Stabilizer</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Uninterruptible Power Supply</td>
<td>SF</td>
<td>D5095230 2950 Uninterruptible power system, 200K to 800 KVA</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Wet Battery Sys and Charger</td>
<td>SF</td>
<td>D5095240 1950 Wet Battery Sys and Charger</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Emergency Lighting</td>
<td>SF</td>
<td>D5095250 2950 Lighting, emergency, dry cell</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Emergency Lighting</td>
<td>SF</td>
<td>D5095250 2950 Lighting, Combo Emergency/Exit</td>
<td>Y</td>
</tr>
<tr>
<td>D509002</td>
<td>EMERGENCY LIGHTING AND POWER</td>
<td>Assemblies include fixtures, motors used for power generation, connection and testing, transfer switches, conduit, wire, battery chargers, batteries, and solar panels</td>
<td>Emergency Lighting</td>
<td>SF</td>
<td>D5095250 3950 Light, emergency, wet cell</td>
<td>Y</td>
</tr>
<tr>
<td>D100002</td>
<td>LOADING DOCK EQUIPMENT</td>
<td>Loading dock equipment</td>
<td>Loading Dock Equipment - Dock Lift, platform type</td>
<td>EA</td>
<td>E1035310 1950 Hydraulic lift, loading dock</td>
<td>Y</td>
</tr>
<tr>
<td>D100002</td>
<td>FOOD SERVICE EQUIPMENT</td>
<td>The unit of measure at the assembly level is the total set of equipment needed in the particular functional space area.</td>
<td>Refrigerator/Freezer, Walk-in Box w/external condenser</td>
<td>EA</td>
<td>E1095382 1950 Refrigerator/Freezer, Walk-in Box w/external condenser</td>
<td>Y</td>
</tr>
<tr>
<td>D100002</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Backhoe</td>
<td>EA</td>
<td>N/A Backhoe</td>
<td>Y</td>
</tr>
</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Backhoe/Tractor</td>
<td>EA</td>
<td>N/A</td>
<td>Backhoe/Tractor</td>
<td>Y</td>
</tr>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Bobcat, Compact Loader</td>
<td>EA</td>
<td>N/A</td>
<td>Bobcat, Compact Loader</td>
<td>Y</td>
</tr>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Cart, Electric Utility (Cushman, Vantage, etc.)</td>
<td>EA</td>
<td>N/A</td>
<td>Cart, Electric Utility (Cushman, Vantage, etc.)</td>
<td>Y</td>
</tr>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Cart, Gas Utility (Scooter/Gator/Mule)</td>
<td>EA</td>
<td>N/A</td>
<td>Cart, Gas Utility (Scooter/Gator/Mule)</td>
<td>Y</td>
</tr>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Crane, Marine Travel Lift</td>
<td>EA</td>
<td>N/A</td>
<td>Crane, Marine Travel Lift</td>
<td>Y</td>
</tr>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Crane, Mobile</td>
<td>EA</td>
<td>N/A</td>
<td>Crane, Mobile</td>
<td>Y</td>
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<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Crane and Personnel Lifts (Manual and Electric Bridge Cranes - up to 5 tons, 5 to 15 tons, and over 15 tons)</td>
<td>EA</td>
<td>N/A</td>
<td>Crane and Personnel Lifts (Manual and Electric Bridge Cranes - up to 5 tons, 5 to 15 tons, and over 15 tons)</td>
<td>Y</td>
</tr>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Forklift, Electric</td>
<td>EA</td>
<td>N/A</td>
<td>Forklift, Electric</td>
<td>Y</td>
</tr>
<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Forklift, Non-Electric</td>
<td>EA</td>
<td>N/A</td>
<td>Forklift, Non-Electric</td>
<td>Y</td>
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<tr>
<td>E109099</td>
<td>OTHER SPECIALIZED FIXED AND MOVEABLE EQUIPMENT</td>
<td>Specialized fixed and moveable equipment not described by the assembly categories listed above.</td>
<td>Light Tower, Portable</td>
<td>EA</td>
<td>N/A</td>
<td>Light Tower, Portable</td>
<td>Y</td>
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</tbody>
</table>

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<tr>
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<th>Description</th>
<th>Permanent</th>
<th>In-Service</th>
<th>Frequency</th>
<th>Remarks</th>
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<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
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<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
</tr>
<tr>
<td>3</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
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<tr>
<td>4</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
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<tr>
<td>5</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
</tr>
<tr>
<td>6</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
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<tr>
<td>7</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
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<tr>
<td>8</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
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<td>M/A</td>
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<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
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<td>10</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
</tr>
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<td>11</td>
<td>OTHER SPECIALIZED F/E AND M/E</td>
<td>Descriptive fixed and moveable equipment and assembly categories listed above. Not described by the listed above.</td>
<td>Y</td>
<td>Y</td>
<td>M/A</td>
<td>M/A</td>
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<td>POTABLE WATER STORAGE</td>
<td>This includes construction and installation of tanks, both at grade and elevated.</td>
<td>Tank, Storage, Ground Level</td>
<td>GAL</td>
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<td>This includes construction and installation of tanks, both at grade and elevated.</td>
<td>Water Flow Meter, turbine</td>
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<td>This includes construction and installation of tanks, both at grade and elevated.</td>
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<td>GAL</td>
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<td>FIRE PROTECTION WATER DISTRIBUTION</td>
<td>This includes construction and installation of piping for fire protection only.</td>
<td>Hydrants (Capture Quantity in one equipment record associated to distribution system)</td>
<td>LF</td>
<td>G3015401950 Fire Hydrant</td>
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<td>This includes construction and installation of piping for fire protection only.</td>
<td>Valve, post indicator</td>
<td>LF</td>
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<td>This includes tanks on grade and elevated for storage of water for fire.</td>
<td>General</td>
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<td>PUMPING STATIONS</td>
<td>This includes construction and installation of pumps, valves, and piping.</td>
<td>Pump, air lift, well</td>
<td>GPM</td>
<td>G30151260950 Pump, air lift, well</td>
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<td>This includes construction and installation of pumps, valves, and piping.</td>
<td>Pump, centrifugal ejector</td>
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<td>Pump, mixed or axial flow velocity</td>
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<td>G30151267950 Pump, sump, up to 1 H.P.</td>
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<td>PACKAGED WATER TREATMENT PLANTS</td>
<td>This includes installation of completely assembled water treatment plants.</td>
<td>Filter plant</td>
<td>GRO</td>
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<td>PACKAGED WATER TREATMENT PLANTS</td>
<td>This includes installation of completely assembled water treatment plants.</td>
<td>Water de-ionization plant</td>
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<td>This includes installation of completely assembled water treatment plants.</td>
<td>Reverse osmosis system, 750 gallons/month</td>
<td>GRO</td>
<td>G30156321950 Reverse osmosis system, 750 gallons/month</td>
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*Table depicts correlation/crosswalk between corresponding UNIFORMAT II Level 4, RS Means Facilities Maintenance and Repair Cost Data (FMRCG), and Coast Guard's Shore Asset Management (SAM) equipment identification systems. Version 1.0
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<th>Level 4 Definition</th>
<th>Component Type</th>
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<th>From UNIFORMAT II (see ASTM E1557)</th>
<th>From RS MEANS FMRCQ Manual</th>
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<td>Sewage Lift Station - General</td>
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<td>1839-Q 1835-S Q/S 20</td>
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<td>G302003</td>
<td>LIFT STATIONS AND PUMPING STATIONS</td>
<td>This includes construction and installation of piping and equipment in lift stations.</td>
<td>Filter, trickling</td>
<td>GPM</td>
<td>G30255401950 Filter, trickling</td>
<td>Y</td>
<td>1848-S S 20</td>
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<td>G302003</td>
<td>LIFT STATIONS AND PUMPING STATIONS</td>
<td>This includes construction and installation of piping and equipment in lift stations.</td>
<td>Grit drive</td>
<td>GPM</td>
<td>G30255421950 Grit drive</td>
<td>Y</td>
<td>1853-S 1850-A S/A 20</td>
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<td>G302003</td>
<td>LIFT STATIONS AND PUMPING STATIONS</td>
<td>This includes construction and installation of piping and equipment in lift stations.</td>
<td>Mixer, sewage</td>
<td>GPM</td>
<td>G30255441950 Mixer, sewage</td>
<td>Y</td>
<td>1861-Q Q 20</td>
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<td>G302003</td>
<td>LIFT STATIONS AND PUMPING STATIONS</td>
<td>This includes construction and installation of piping and equipment in lift stations.</td>
<td>Septic Tank</td>
<td>GAL</td>
<td>Septic Tank</td>
<td>Y</td>
<td>5280-A A 30</td>
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*Table depicts correlation/crosswalk between corresponding UNIFORMAT II Level 4, RS Means Facilities Maintenance and Repair Cost Data (FMRCQ), and Coast Guard's Shore Asset Management (SAM) equipment identification systems.
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<tr>
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<th>Material / Equipment Category</th>
<th>Level 4 Definition</th>
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<th>UOM</th>
<th>From RS MEANS FMRCD Manual</th>
<th>From U. S. Coast Guard SAM database</th>
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<tr>
<td>G300003</td>
<td>LIFT STATIONS</td>
<td>This includes construction of lift stations including piping, pumps, and controls.</td>
<td>Lift Station (Storm Sewer)</td>
<td>GPM</td>
<td>Lift Station (Storm Sewer)</td>
<td>Y NEED TO DEVELOP SAM JP</td>
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<td>G305006</td>
<td>ON-SITE COOLING TOWERS</td>
<td>On-site cooling towers.</td>
<td>Cooling Tower</td>
<td>EA</td>
<td>Cooling tower, water, forced draft, up to 50 tons</td>
<td>Y 1739-S</td>
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<tr>
<td>G305006</td>
<td>ON-SITE COOLING TOWERS</td>
<td>On-site cooling towers.</td>
<td>Cooling Tower</td>
<td>EA</td>
<td>Cooling tower, water, forced draft, 50 thru 1000 tons</td>
<td>Y 1757-S</td>
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<td>G305006</td>
<td>ON-SITE COOLING TOWERS</td>
<td>On-site cooling towers.</td>
<td>Cooling Tower</td>
<td>EA</td>
<td>Cooling tower, water, forced draft, 500 to 1000 tons</td>
<td>Y 1753-S</td>
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<tr>
<td>G306001</td>
<td>LIQUID FUEL DISTRIBUTION PIPING</td>
<td>This includes installation of piping for fuel oil distribution. This includes equipment related to piping, system leak detection, and tightness testing.</td>
<td>General</td>
<td>LF</td>
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<td>Y NEED TO DEVELOP SAM JP</td>
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<td>G306002</td>
<td>AVIATION FUEL DISTRIBUTION PIPING SYSTEM</td>
<td>This includes installation of piping for aviation fuel distribution and equipment related to the piping. This includes system leak detection and tightness testing.</td>
<td>General</td>
<td>LF</td>
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<td>Y NEED TO DEVELOP SAM JP</td>
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<td>G306003</td>
<td>LIQUID FUEL DISPENSING EQUIPMENT</td>
<td>This includes installation of buried or above ground fuel tanks.</td>
<td>General</td>
<td>GAL</td>
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<td>Y NEED TO DEVELOP SAM JP</td>
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<td>G306004</td>
<td>LIQUID FUEL STORAGE TANKS</td>
<td>Liquid fuel storage tanks.</td>
<td>Tank, Fuel Oil, above ground</td>
<td>EA</td>
<td>Tank, Fuel Oil, above ground</td>
<td>Y 1942-A</td>
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<td>G306007</td>
<td>GAS STORAGE TANKS</td>
<td>This includes installation of tanks for natural or propylene gas.</td>
<td>Tank, Fuel Oil, above ground</td>
<td>GAL</td>
<td>Tank, Fuel Oil, above ground</td>
<td>Y 1942-A</td>
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<tr>
<td>G309003</td>
<td>INDUSTRIAL WASTE LIFT STATIONS</td>
<td>This includes construction and installation of industrial waste lift stations and equipment.</td>
<td>General</td>
<td>GPM</td>
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<td>Y NEED TO DEVELOP SAM JP</td>
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<tr>
<td>G309004</td>
<td>INDUSTRIAL WASTE HOLDING TANKS AND SEPARATORS</td>
<td>This includes construction or installation of special tanks such as sludge recovery tanks or separators such as oil water separators.</td>
<td>General</td>
<td>EA</td>
<td></td>
<td>Y NEED TO DEVELOP SAM JP</td>
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<tr>
<td>G401001</td>
<td>SUBSTATIONS</td>
<td>This system includes substation equipment and materials required from the primary power source.</td>
<td>General</td>
<td>KVA</td>
<td></td>
<td>Y 9060-S</td>
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<tr>
<td>G401002</td>
<td>TRANSFORMERS</td>
<td>Electrical power transformers used in conjunction with electrical substations. May include pole/tower or pad-mounted transformers.</td>
<td>Transformer, Dry Type 500 KVA and over</td>
<td>KVA</td>
<td>Transformer, Dry Type 500 KVA and over</td>
<td>Y 2024-A</td>
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<tr>
<td>G401002</td>
<td>TRANSFORMERS</td>
<td>Electrical power transformers used in conjunction with electrical substations. May include pole/tower or pad-mounted transformers.</td>
<td>Transformer, Oil, Pad Mounted</td>
<td>KVA</td>
<td>Transformer, Oil, Pad Mounted</td>
<td>Y 2025-A</td>
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<tr>
<td>G401002</td>
<td>TRANSFORMERS</td>
<td>Electrical power transformers used in conjunction with electrical substations. May include pole/tower or pad-mounted transformers.</td>
<td>Transformer, Oil, Pad Mounted PCB</td>
<td>KVA</td>
<td>Transformer, Oil, Pad Mounted PCB</td>
<td>Y 2027-Q, 2026-A</td>
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<td>G401003</td>
<td>SWITCHES, CONTROLS AND DEVICES</td>
<td>Includes all components of switchgear, voltage regulators and busbars used with electrical substations.</td>
<td>General</td>
<td>EA</td>
<td>Y 9060-S</td>
<td>S</td>
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<tr>
<td>G401003</td>
<td>SWITCHES, CONTROLS AND DEVICES</td>
<td>Includes all components of switchgear, voltage regulators and busbars used with electrical substations.</td>
<td>Panel board</td>
<td>D50152601950</td>
<td>Panelboard, 225 Amps and above</td>
<td>Y 2029-A</td>
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<td>G402099</td>
<td>OTHER AREA LIGHTING</td>
<td>Includes components and equipment used for area lighting.</td>
<td>Street lighting (Capture quantity in one equipment record associated to the Sub Location Parent)</td>
<td>LF</td>
<td>Y NEED TO DEVELOP SAM JP</td>
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<tr>
<td>G402099</td>
<td>OTHER AREA LIGHTING</td>
<td>Includes components and equipment used for area lighting.</td>
<td>Airfield lighting</td>
<td>LF</td>
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<td>G403003</td>
<td>FIRE ALARM SYSTEMS</td>
<td>Includes all components, cables, and equipment used in conjunction with exterior fire alarm systems.</td>
<td>General</td>
<td>LF</td>
<td>Y NEED TO DEVELOP SAM JP</td>
<td>25</td>
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<td>G409001</td>
<td>SACRIFICIAL ANODE CATHODIC PROTECTION SYSTEM</td>
<td>Includes all components required in conjunction with sacrificial anode system.</td>
<td>Sacrificial Anode Cathodic Protection System</td>
<td>G40951101950</td>
<td>Cathodic Protection System</td>
<td>Y 1665-S</td>
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<tr>
<td>G409002</td>
<td>INDUCED CURRENT CATHODIC PROTECTION SYSTEM</td>
<td>Includes conductors and termination required for cathodic protection.</td>
<td>Induced Current Cathodic Protection System</td>
<td>G40951101950</td>
<td>Cathodic Protection System</td>
<td>Y 1665-S</td>
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<td>G409003</td>
<td>EMERGENCY POWER GENERATION</td>
<td>Emergency power generation.</td>
<td>Generators</td>
<td>D50952101950</td>
<td>Emergency Generator, up to 15 KVA</td>
<td>Y 1647-M1648-A</td>
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<td>G409003</td>
<td>EMERGENCY POWER GENERATION</td>
<td>Emergency power generation.</td>
<td>Generators</td>
<td>D50952102950</td>
<td>Emergency Generator, over 15 KVA</td>
<td>Y 1660-M1664-A</td>
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<td>G409003</td>
<td>EMERGENCY POWER GENERATION</td>
<td>Emergency power generation.</td>
<td>Generators</td>
<td>D50952103950</td>
<td>Emergency diesel generator, turbine</td>
<td>Y 1748-M1747-A</td>
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<td>G409009</td>
<td>OTHER CATHODIC PROTECTION</td>
<td>Includes components and equipment used in conjunction with other cathodic protection systems not defined above.</td>
<td>General</td>
<td>G40951101950</td>
<td>Cathodic Protection System</td>
<td>Y 1665-S</td>
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<td>H105001</td>
<td>LIFE RINGS</td>
<td>Life rings.</td>
<td>Life Rings</td>
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<td>OIL CONTAINMENT BOOM FIXED SYSTEM</td>
<td>Oil containment boom fixed system.</td>
<td>Oil Containment Boom, Fixed</td>
<td>LS</td>
<td>Y 1310-S</td>
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<td>H105003</td>
<td>OIL CONTAINMENT BOOM PORTABLE SYSTEM</td>
<td>Oil containment boom portable system.</td>
<td>Oil Containment Boom, Portable</td>
<td>LS</td>
<td>Y 3332-S</td>
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<td>H105004</td>
<td>GANGWAYS AND BROWS</td>
<td>Gangways and brows.</td>
<td>Gangways AND Brows</td>
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<td>Frequency</td>
<td>Design Life</td>
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<td>POTABLE WATER</td>
<td>Potable water</td>
<td>Shore Tie, Potable Water</td>
<td>LS</td>
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<td>5617-Q 7311 A 9074-A (Add 9074 for Cold Climate)</td>
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<td>SANITARY SEWER</td>
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<td>5617-Q 7311 A 9074-A (Add 9074 for Cold Climate)</td>
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<td>OTHER CIVIL/MECHANICAL UTILITIES</td>
<td>Shore tie, other civil/mechanical utilities</td>
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<td>Panel board</td>
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<td>Switchboard</td>
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<td>H502001</td>
<td>POWER DISTRIBUTION SYSTEM</td>
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<td>Transformer, Dry Type 500 KVA and over</td>
<td>LS</td>
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<td>POWER DISTRIBUTION SYSTEM</td>
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<td>Transformer, Oil, Pad Mounted</td>
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<td>Y</td>
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<td>Motor Control center</td>
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<td>TELECOMMUNICATION SYSTEM</td>
<td>Telecommunication</td>
<td>Telecommunication System</td>
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<td>WATERSIDE ATFP</td>
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Version 1.0
SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201 (2002; R 2011) Fans and Systems
AMCA 210 (2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300 (2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301 (2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D (2018) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 440 (2008) Performance Rating of Room Fan-Coils
AHRI 880 I-P (2011) Performance Rating of Air Terminals
AHRI 885 (2008; Addendum 2011) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 70 (2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASME INTERNATIONAL (ASME)


ASTM INTERNATIONAL (ASTM)


ASTM D520 (2000; R 2011) Zinc Dust Pigment


CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2016; SUPP 20162018) Motors and Generators

Medium AC Squirrel-Cage Polyphase Induction Motors


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)


SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

U.S. DEPARTMENT OF ENERGY (DOE)


U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 6 (2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel

UL 181 (2013; Reprint Apr 2017) UL Standard for Safety Factory-Made Air Ducts and Air Connectors


UL Bld Mat Dir (updated continuously online) Building Materials Directory
1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Color Coding

Color coding of all piping systems must be in accordance with ASME A13.1.

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Detail Drawings
SD-03 Product Data
   Insulated Nonmetallic Flexible Duct Runouts
   Duct Connectors
   Duct Access Doors
   Manual Balancing Dampers
   Diffusers
   Registers and Grilles
   Return Duct Fan
   In-Line Exhaust Fans
   Energy Star label for In-Line Exhaust Fan product
   Room Fan-Coil Units
   Variable Volume, Single Duct Terminal Units
   Condensate Pumps
   Automatic Balance Damper
   Fabric Blade Backdraft Dampers
SD-06 Test Reports
   Performance Tests
SD-08 Manufacturer's Instructions
Operation and Maintenance Training
SD-10 Operation and Maintenance Data
Operation and Maintenance Manuals
Return Duct Fan
In-Line Exhaust Fans
Room Fan-Coil Units

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide hot-dip galvanized ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F...
1.4.4 Detail Drawings

Work Item #1: Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of new mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Provide identification plates that are layers, black-white-black, engraved to show white letters on black background. Letters must be upper case. Identification plates that are 1-1/2-inches high and smaller must be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high must be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger must have beveled edges. Install identification plates using a compatible adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact.
according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

2.4 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide premium efficiency type integral size motors in accordance with NEMA MG 1.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

e. Provide variable frequency drives for motors as specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.

2.5 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.6 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.7 DUCT SYSTEMS

2.7.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this
specification.

a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

b. Provide ductwork that meets the requirements of Seal Class A. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.

c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Provide duct sealant products that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table).

d. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.7.1.1 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.7.1.2 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector.
Repair HVAC & Reconfigure Intel SCIF

system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.7.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.7.3 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.7.4 Automatic Balance Damper

The automatic balance damper shall be self contained, have a manually adjustable set point for constant air volume control with differential air pressure up to 2 inches water column. The automatic balance damper shall be compact, insertable into standard ductwork with integral sealing feature, anti-microbial and suitable for service in 25 to 150 F air temperature. Performance shall be plus or minus 10 percent of the adjustable set point, tested inaccordance with AMCA 500-D-18. Classified by UL 2043 for heat and visible smoke release. The automatic balance damper shall be suitable for supply or exhaust applications in vertical or horizontal configurations.

2.7.5 Fabric Blade Backdraft Dampers

Neoprene coated fiberglass blades in 16 gage galvanized steel frame with expanded galvanized metal grill with 60% free area for quiet operation. Fire resistant suitable for 1000 fpm air velocity and horizontal or vertical up configurations. Leakage rate less than 3.5 cfm/sf at 0.2 inches water column.

2.7.6 Diffusers, Registers, and Grilles

Provide factory-fabricated units of steel or aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified
performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.7.6.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Install ceiling mounted units with rims tight against ceiling. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide molded insulated back pan covers for ceiling diffusers. Provide air baffles where directional flow is indicated.

2.7.6.2 Registers and Grilles

Where new registers and grills are indicated, provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound rating of the fans must not exceed the indicated ratings when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published
loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300.

2.8.1.1 Return Duct Fan

Work Item 1 for RF-3 application. Provide propeller type fans, assembled on a reinforced metal panel with venturi opening spun into panel. Provide direct or V-belt driven fans with wheels less than 24 inches in diameter and provide V-belt driven fans with wheels 24 inches in diameter and larger. Provide fans with wall mounting collar for installation in a return duct with access as indicated for fan maintenance. Provide lubricated bearings. Equip fans with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Provide totally enclosed fan cooled type motor enclosure.

2.8.1.2 In-Line Exhaust Fans


2.9 TERMINAL UNITS

2.9.1 Room Fan-Coil Units

Provide base units that include galvanized coil casing, coil assembly drain pan valve and piping package, air filter, fans, motor, fan drive, motor switch, an enclosure for cabinet models and casing for concealed models, leveling devices integral with the unit for vertical type units, and sound power levels as indicated. Obtain sound power level data or values for these units according to test procedures based on AHRI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models are acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Fasten each unit securely to the building structure. Provide units with capacity indicated. Provide room fan-coil units that are certified as complying with AHRI 440, and meet the requirements of UL 1995.

2.9.1.1 Enclosures

Fabricate enclosures from not lighter than 18 gauge steel, reinforced and braced. Provide galvanized or factory finished ferrous metal surfaces with corrosion resistant enamel, and access doors or removable panels for piping and control compartments, plus easy access for filter replacement. Provide duct discharge collar for concealed models.

2.9.1.2 Fans

Provide steel or aluminum, multiblade, centrifugal type fans. In lieu of metal, fans and scrolls could be of non-metallic materials of suitably reinforced compounds with smooth surfaces. Dynamically and statically balance the fans. Provide accessible assemblies for maintenance.
Disassemble and re-assemble by means of mechanical fastening devices and not by epoxies or cements.

2.9.1.3 Coils

Fabricate coils from not less than 3/8 inch outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Provide coils with not less than 1/2 inch outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Test coils hydrostatically at 300 psi or under water at 250 psi air pressure. Provide coils suitable for 200 psi working pressure. Make provisions for coil removal.

2.9.1.4 Drain Pans

Size and locate drain and drip pans to collect all water condensed on and dripping from any item within the unit enclosure or casing. Provide condensate drain pans designed for self-drainage to preclude the buildup of microbial slime and thermally insulated to prevent condensation and constructed of not lighter than 21 gauge type 304 stainless steel or noncorrosive ABS plastic. Provide insulation with a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and of a waterproof type or coated with a waterproofing material. Design drain pans so as to allow no standing water and pitch to drain. Provide minimum 3/4 inch NPT or 5/8 inch OD drain connection in drain pan. Provide plastic or metal auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages; if metal, provide auxiliary pans that comply with the requirements specified above. Extend insulation at control and piping connections 1 inch minimum over the auxiliary drain pan.

2.9.1.5 Filters

Provide disposable type filter that complies with ASHRAE 52.2. Provide filters in each unit that are removable without the use of tools.

2.9.1.6 Motors

Provide motors of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Provide motor switch with two or three speeds and off, manually operated, and mounted on an identified plate inside the unit below or behind an access door. In lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent is allowed. Provide motors with permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Provide a motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity that does not exceed the following values:
Free Discharge Motors

<table>
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<tr>
<th>Unit Capacity (cfm)</th>
<th>Maximum Power Consumption (Watts)</th>
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<td></td>
<td>115V</td>
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<td>1200</td>
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High Static Motors

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<th>Unit Capacity (cfm)</th>
<th>Maximum Power Consumption (Watts)</th>
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<tbody>
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<td>1200</td>
<td>530</td>
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</table>

2.9.2 Variable Air Volume (VAV) Terminal Units

a. Provide VAV and dual duct terminal units that are the type, size, and capacity shown, mounted in the ceiling or wall cavity, plus units that are suitable for single or dual duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

b. Provide unit enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools.
c. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the calculations prepared in accordance with AHRI 885. Provide sound power level as indicated. Show discharge sound power for minimum and 1-1/2 inches water gauge inlet static pressure. Provide acoustical lining according to NFPA 90A.

2.9.2.1 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.10 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer's representative in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.11 SUPPLEMENTAL COMPONENTS/SERVICES

2.11.1 Chilled, Condenser, or Dual Service Water Piping

The requirements for chilled water piping and accessories are specified in Section 23 64 26 CHILLED WATER PIPING SYSTEMS

2.11.2 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 81 00 MINI-SPLIT HEAT PUMPS AND AIR CONDITIONERS

2.11.3 Heating System Accessories

The requirements for water heating accessories are specified in Section 23 57 10.00 10 HOT WATER HEATING SYSTEM.

2.11.4 Condensate Pumps

Impeller type pump with automatic start stop operation with tank and discharge check valve, high level condensate detection switch and test level. Unit shall be wall mountable and be available with anti-sweat tank insulation. Unit shall be designed for ease of maintainance. Where indicated provide with aesthetic cover to conceal. Cover may be a commercial product or custom fabricated of corrosion resistant material. Cover finish
shall match adjacent wall color and installed to allow easy removable for pump maintenance.

For mini-split air conditioner applications, see Section 23 81 00 MINI-SPLIT HEAT PUMPS AND AIR CONDITIONERS.

2.11.5 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 23 64 26 CHILLED WATER PIPING SYSTEMS or Section 23 81 00 MINI-SPLIT HEAT PUMPS AND AIR CONDITIONERS except as modified herein.

2.11.6 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.11.7 Controls

The requirements for controls are specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices) and an additional feet.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain where indicated or directed. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains.
indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 Acoustical Duct Lining

No duct lining is anticipated. However incidental work where duct lining is repaired or replaced, apply lining in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C916, Type I, NFPA 90A, UL 723, and ASTM E84. Provide top and bottom pieces that lap the side pieces and are secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA 1966. Provide welded pins, cup-head pins, or adhered clips that do not distort the duct, burn through, nor mar the finish or the surface of the duct. Make pins and washers flush with the surfaces of the duct liner and seal all breaks and punctures of the duct liner coating with the nonflammable, fire resistant adhesive. Coat exposed edges of the liner at the duct ends and at other joints where the lining is subject to erosion with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Apply duct liner to flat sheet metal prior to forming duct through
the sheet metal brake. Additionally secure lining at the top and bottom surfaces of the duct by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA 1966 to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, are acceptable.

3.2.7 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day’s work. Keep temporary protection in place until system is ready for startup.

3.2.8 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums up to the point where the outdoor air reaches the conditioning unit or up to the point where the outdoor air mixes with the return air stream.

3.2.9 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.10 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer’s maximum allowable range of misalignment.

3.3 Cutting and Patching

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.4 Cleaning

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces.
3.5 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.5.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

3.5.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.5.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.5.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.5.5 Firestopping

Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials.
3.6 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.6.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.6.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

3.6.3 Temperatures greater than 400 degrees F

Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

3.6.4 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, shall be as indicated.

3.7 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.8 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.9 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the
system and temperatures and conditions are evenly controlled throughout the
building. Make corrections and adjustments as necessary to produce the
conditions indicated or specified. Conduct capacity tests and general
operating tests by an experienced technician. Provide tests that cover a
period of not less than 3 days for each system and demonstrate that the
entire system is functioning according to the specifications.

Submit test reports for the performance tests upon completion of testing.
Document phases of tests performed including initial test summary,
repairs/adjustments made, and final test results in the reports.

3.10 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from
passing through coils. Inside of room fan-coil units thoroughly clean
ducts, plenums, and casing of debris and blow free of small particles of
rubbish and dust and then vacuum clean before installing outlet faces.
Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots.
Provide temporary filters prior to startup of all fans that are operated
during construction, and provide new filters after all construction dirt
has been removed from the building, and the ducts, plenums, casings, and
other items specified have been vacuum cleaned. Maintain system in this
clean condition until final acceptance. Properly lubricate bearings with
oil or grease as recommended by the manufacturer. Tighten belts to proper
tension. Adjust control valves and other miscellaneous equipment requiring
adjustment to setting indicated or directed. Adjust fans to the speed
indicated by the manufacturer to meet specified conditions. Maintain all
equipment installed under the contract until close out documentation is
received, the project is completed and the building has been documented as
beneficially occupied.

3.11 OPERATION AND MAINTENANCE

3.11.1 Operation and Maintenance Manuals

Submit in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS operation
and maintenance manuals at least 2 weeks prior to field training.

3.11.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as
designated by the Contracting Officer's representative. Make the training
period consist of a total of 4 hours of normal working time and start it
after all work specified herein is functionally completed and the
Performance Tests have been approved. Conduct field instruction that
covers all of the items contained in the Operation and Maintenance Manuals
as well as demonstrations of routine maintenance operations. Submit the
proposed On-site Training schedule concurrently with the Operation and
Maintenance Manuals and at least 7 days prior to conducting the training
course.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 203  (1990; R 2011) Field Performance Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)


ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-4  (1996) Test and Balance Procedures

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)


SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)


1.2 DEFINITIONS

a. AABC: Associated Air Balance Council
b. COR: Contracting Officer's Representative
c. DALT: Duct air leakage test
d. DALT'd: Duct air leakage tested

e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling

f. NEBB: National Environmental Balancing Bureau

g. Out-of-tolerance data: Pertains only to field acceptance testing of Final TAB report. When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.

i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.

j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.

k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).

l. TAB: Testing, adjusting, and balancing (of HVAC systems)

m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed

n. TAB Agency: TAB Firm

o. TAB team field leader: TAB team field leader

p. TAB team supervisor: TAB team engineer

q. TAB team technicians: TAB team assistants

r. TABB: Testing Adjusting and Balancing Bureau

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.
1.3 WORK DESCRIPTION

The work includes testing, adjusting, and balancing (TAB) of new and existing heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct TAB of the indicated existing systems and equipment and submit the specified TAB reports for approval. Conduct TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain Contracting Officer's representative's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 Water Distribution Systems

TAB systems in compliance with this section. Obtain Contracting Officer's representative's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe...
insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.
2. Air quantities at air terminals.
3. Air quantities and temperatures in air handling unit schedules.
4. Water quantities and temperatures in thermal energy transfer equipment schedules.
5. Water quantities and heads in pump schedules.
6. Water flow measurement fittings and balancing fittings.

Submit specified number of copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field measurements.

1.3.4 Related Requirements

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

TAB Firm

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms

SD-03 Product Data

Calibration

SD-06 Test Reports

TAB Report

SD-07 Certificates

Independent TAB Agency and Personnel Qualifications

TAB Firm
1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

   TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

   TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

   TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

   TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

   Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB...
Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.3 Qualifications

1.5.3.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems.

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid by the Contractor.

1.5.3.2 TAB Specialist

The TAB Specialist must be either a member of AABC, an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.5.3.3 TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is
required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist must participate in the commissioning process.

1.5.4 Test Reports

1.5.4.1 Certified TAB Reports

Submit: TAB Report in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

   (1) AHU-3 air distribution, FCU air distribution, chilled water system and heating hot water system. Measure and compile data on a continuous basis for the period in which TAB work affecting those rooms is being done.

   (2) Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

   (3) Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the Tab Report.

c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems including: AHU-3. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

   (1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

   (2) Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.
(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

(4) Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(5) Report static pressure drop across outside air and relief/exhaust air louvers.

(6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.

e. Duct Traverses: Report duct traverses for main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.
1.6 PROJECT/SITE CONDITIONS

1.6.1 TAB Services to Obtain Existing Conditions

Conduct TAB of the indicated existing systems and equipment and submit the specified TAB reports for approval. Conduct this TAB work in accordance with the requirements of this section.

1.7 SEQUENCING AND SCHEDULING

1.7.1 Projects with Phased Construction

This specification section is structured as though the HVAC construction, and thereby the TAB work, will be completed in a single phase. When the construction is completed in phases, the TAB work must be planned, completed, and accepted for each construction phase.

1.7.1.1 Phasing of Work

This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase. All elements of the TAB work are addressed on this premise. When a contract is to be completed in construction phases, including the TAB work, the TAB work, completed and approved by the Contracting Officer with each phase. An example of this case would be one contract that requires the rehabilitation of the HVAC in each of several separated buildings. At the completion of the final phase, compile all approved reports and submit as one document.

1.8 WARRANTY

Furnish workmanship and performance warranty for the TAB system work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB firm. The Contractor must also provide a 1 year contractor installation warranty.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section.

3.2 PRE-TAB MEETING

Meet with the Contracting Officer's representative (COR) to develop a
mutual understanding relative to the details of the TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 TAB PROCEDURES

3.3.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the requirements of AABC MN-1 or SMACNA 1780 (TABB) and SMACNA 1858 (TABB), except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.

3.3.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.3.3 TAB Air Distribution Systems

3.3.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, chilled water, DX and steam coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity.
in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.3.3.2 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.3.4 TAB Water Distribution Systems

3.3.4.1 Chilled Water

Chilled water systems including chillers, condensers, cooling towers, pumps, coils, system balance valves and flow measuring devices.

For water chillers, report data as required by AABC, NEBB and TABB standard procedures, including refrigeration operational data.

3.3.4.2 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g., heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

3.3.5 TAB Work on Performance Tests Without Seasonal Limitations

3.3.5.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and cooling systems.

3.3.5.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.3.5.3 Coils

Report heating and cooling performance capacity tests for hot water, chilled water, for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:
a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing".

Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

3.3.6 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

3.3.7 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph WORKMANSHIP, provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.3.8 TAB Reports

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP.

3.3.9 Quality Assurance - COR TAB Field Acceptance Testing

3.3.9.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COR, random selections of data (water, air quantities, air motion,) recorded in
Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

- **Group 1:** All chillers, boilers, return fans, computer room units, and air handling units (rooftop and central stations).
- **Group 2:** 25 percent of the VAV terminal boxes and associated diffusers and registers.
- **Group 3:** 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.
- **Group 4:** 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.
- **Group 5:** 25 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

### 3.3.9.2 Additional COR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COR.

Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

### 3.3.9.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

### 3.4 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent
markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.5 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Contracting Officer, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)


ASTM INTERNATIONAL (ASTM)


ASTM D882 (2012) Tensile Properties of Thin Plastic Sheeting


CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)


FM GLOBAL (FM)

GREEN SEAL (GS)

GS-36 (2013) Adhesives for Commercial Use

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)


MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds (8th Ed) National Commercial & Industrial Insulation Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T403 OM (2015) Bursting Strength of Paper

U.S. DEPARTMENT OF DEFENSE (DOD)


MIL-PRF-19565 (1988; Rev C) Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier

UNDERWRITERS LABORATORIES (UL)


UL 723 (2018) UL Standard for Safety Test for
1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings
   MICA Plates
SD-03 Product Data
   Pipe Insulation Systems
   Duct Insulation Systems
   Equipment Insulation Systems
SD-07 Certificates

Indoor air quality for adhesives

1.4 CERTIFICATIONS

1.4.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.
1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer's representative may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet.

2.1.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems. Provide CFC and HCFC free insulation.

2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation must have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flame spread, and smoke developed indexes, shall be determined by ASTM E84 or UL 723. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Prepare and mount test specimens according to ASTM E2231.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.2. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C795 requirements. Calcium silicate shall not be used on chilled or cold water systems. Materials shall be asbestos free. Provide product
recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

2.2.1 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants must meet limit requirements of "Other" category within SCAQMD Rule 1168 sealants table). Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, lagging adhesive shall meet ASTM D5590 with 0 growth rating. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.4 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.
2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 3105, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.
2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, ultraviolet (UV) resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

2.2.8.4 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

a. On ducts, piping and equipment operating below 65 degrees F or located outside shall be equipped with a vapor barrier.

b. Ducts, pipes and equipment that are located inside and that always operate above 65 degrees F shall be installed with a vapor retarder where required as stated in paragraph VAPOR RETARDER REQUIRED.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomers require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.
2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

2.2.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be 0.013 perms or less at 43 mils dry film thickness as determined according to procedure B of ASTM E96/E96M utilizing apparatus described in ASTM E96/E96M. The coating shall be nonflammable, fire resistant type. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be in accordance with ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with TAPPI T403 OM. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.
2.2.10  Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.11  Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12  Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13  Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.3  PIPE INSULATION SYSTEMS

Conform insulation materials to Table 1 and minimum insulation thickness as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1 - SI. Limit pipe insulation materials to those listed herein and meeting the following requirements:

2.3.1  Recycled Materials

Provide insulation materials containing the following minimum percentage of recycled material content by weight:

Fiberglass: 20 percent glass cullet

2.3.2  Aboveground Cold Pipeline ( -30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

2.3.2.1  Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I, Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Type I and II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

2.3.3  Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.
2.3.3.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3.2 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II to 220 degrees F service. Type I for tubular materials. Type II for sheet materials.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Factory Applied Insulation

Provide factory-applied ASTM C534/C534M Grade I, Type II, flexible elastomeric closed cell insulation according to manufacturer's recommendations for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier.

2.4.1.1 Rigid Insulation

Calculate the minimum thickness in accordance with ASHRAE 90.1.

2.4.1.2 Blanket Insulation

Calculate minimum thickness in accordance with ASHRAE 90.1.

2.4.2 Acoustical Duct Lining

2.4.2.1 General

For ductwork indicated or specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM to be acoustically lined, provide external insulation in accordance with this specification section and in addition to the acoustical duct lining. Do not use acoustical lining in place of duct wrap or rigid board insulation (insulation on the exterior of the duct).

2.4.2.2 Duct Liner

Flexible Elastomeric Acoustical and Conformable Duct Liner Materials: Flexible Elastomeric Thermal, Acoustical and Conformable Insulation Compliance with ASTM C534/C534M Grade I, Type II; and NFPA 90A or NFPA 90B as applicable.

2.4.3 Duct Insulation Jackets

2.4.3.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.
2.4.3.2 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 5 and 6. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Submit a booklet containing manufacturer's published installation instructions for the insulation systems. The instructions must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as indicated. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.
3.1.3 Painting and Finishing

Painting shall be as indicated.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

3.1.4.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.4.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer’s representative. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:
a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

Provide an aluminum jacket or vapor barrier/weatherproofing self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder over the insulation wherever penetrations require sealing.

3.2.1.2.1 Penetrate Interior Walls

The aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the
end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant.

3.2.1.3 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-58. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above Supported on hangers in accordance with MSS SP-58.

3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-58. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

3.2.1.3.3 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-58 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

3.2.1.3.4 Inserts

Covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2 inches, and seal as required for the pipe jacket. The jacket material used
to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

### 3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation. Type II requires an additional exterior vapor retarder/barrier covering for high relative humidity and below ambient temperature applications.

### 3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, welded PVC, aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

### 3.2.1.6 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements of ASHRAE 90.1.

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Specification</th>
<th>Type</th>
<th>Class</th>
<th>VR/VB Req’d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water (Supply &amp; Return, Glycol Mixture Piping, 40 F nominal)</td>
<td>Flexible Elastomeric Cellular</td>
<td>ASTM C534/C534M</td>
<td>I</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Heating Hot Water Supply &amp; Return (Max 250 F), Note 1</td>
<td>Mineral Fiber</td>
<td>ASTM C547</td>
<td>I</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Flexible Elastomeric Cellular</td>
<td>ASTM C534/C534M</td>
<td>I</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>Cold Domestic Water Piping, Makeup Water &amp; Drinking Fountain Drain Piping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 1

**Insulation Material for Piping**

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Specification</th>
<th>Type</th>
<th>Class</th>
<th>VR/VB Req’d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Domestic Water Supply &amp; Recirculating Piping (Max 200 F)</td>
<td>Flexible Elastomeric Cellular</td>
<td>ASTM C534/C534M</td>
<td>I</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Hot Domestic Water Supply &amp; Recirculating Piping (Max 200 F)</td>
<td>Mineral Fiber</td>
<td>ASTM C547</td>
<td>I</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>Refrigerant Suction Piping (35 degrees F nominal)</td>
<td>Flexible Elastomeric Cellular</td>
<td>ASTM C534/C534M</td>
<td>I</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Condensate Drain Located Inside Building</td>
<td>Flexible Elastomeric Cellular</td>
<td>ASTM C534/C534M</td>
<td>I</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Note: VR/VB = Vapor Retarder/Vapor Barrier
1. Match existing insulation where flexible elastomeric is installed.

### TABLE 2

**Piping Insulation Thickness (inch)**

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Tube And Pipe Size (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water (Supply &amp; Return, Glycol Mixture Piping, 40 Degrees F nominal)</td>
<td>Flexible Elastomeric Cellular</td>
<td>1 1 1 N/A N/A</td>
</tr>
<tr>
<td>Heating Hot Water Supply &amp; Return (Max 250 F)</td>
<td>Mineral Fiber</td>
<td>1.5 1.5 2 2 2</td>
</tr>
<tr>
<td>Cold Domestic Water Piping, Makeup Water &amp; Drinking Fountain Drain Piping</td>
<td>Flexible Elastomeric Cellular</td>
<td>1 1 1 N/A N/A</td>
</tr>
<tr>
<td>Hot Domestic Water Supply &amp; Recirculating Piping (Max 200 F)</td>
<td>Flexible Elastomeric Cellular</td>
<td>N/A N/A</td>
</tr>
</tbody>
</table>

**SECTION 23 07 00 Page 17**
TABLE 2

Piping Insulation Thickness (inch)

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Tube And Pipe Size (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;1</td>
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<tr>
<td></td>
<td>Mineral Fiber</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
</tr>
<tr>
<td>Refrigerant Suction Piping (35 degrees F nominal)</td>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
</tr>
<tr>
<td>Condensate Drain Located Inside Building</td>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
</tr>
</tbody>
</table>

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Make-up water.

b. Refrigerant suction lines.

c. Chilled water.

d. Air conditioner condensate drains.

e. Domestic cold water.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation
and vapor retarder jacket installed as specified herein. The aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, shall be provided for pipe insulation to the 6 ft level. Other areas that specifically require protection to the 6 ft level are outdoor refrigerant lines.

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or repair the gap by applying adhesive under the lap and then stapling.

3.2.2.3.4 Staples

Coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Coat all seams, except those on factory self-seal systems, with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.5 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.
3.2.2.3.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives. Do not stretch Grade 1, Type II sheet insulation around the pipe when used on pipe larger than 6 inches. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 'Mitered Insulation Elbow'. Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.

(1) The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including locations, materials, vaporproofing, jackets and insulation accessories.

(2) If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and
insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

b. Hot water heating.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden.
from view by the insulation.

3.2.3.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

3.2.3.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with metal jacketing/flashing sealant while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.
3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.

<table>
<thead>
<tr>
<th>Table 4 - Minimum Duct Insulation (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Air Ducts</td>
</tr>
<tr>
<td>Relief Ducts</td>
</tr>
<tr>
<td>Fresh Air Intake Ducts</td>
</tr>
<tr>
<td>Warm Air Ducts</td>
</tr>
<tr>
<td>Relief Ducts</td>
</tr>
<tr>
<td>Fresh Air Intake Ducts</td>
</tr>
</tbody>
</table>

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be...
continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush
coat of vapor retarder coating. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.

b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Impale insulation on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Seal joints in the insulation jacket with a 4 inch wide strip of tape. Seal taped seams with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a flashing sealant.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air
ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts.

c. Relief air ducts

d. Flexible run-outs (field insulated).

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paintable, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with
minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.5 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:


b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.
f. Duct Test/Balance Test Holes.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Refrigeration equipment parts that are not factory insulated.

b. Drip pans under chilled equipment.

c. Cold and chilled water pumps.

d. Air handling equipment parts that are not factory insulated.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Material and thicknesses shall be as shown in Table 5:

<table>
<thead>
<tr>
<th>TABLE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation Thickness for Cold Equipment (inches)</td>
</tr>
<tr>
<td>Equipment handling media at indicated temperature</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 to 60 degrees F</td>
<td></td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
</tr>
<tr>
<td>1 to 34 degrees F</td>
<td></td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular</td>
<td>1.5</td>
</tr>
<tr>
<td>Minus 30 to 0 degrees F</td>
<td></td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular</td>
<td>1.75</td>
</tr>
</tbody>
</table>

3.4.2.2 Pump Insulation

a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Exposed insulation corners shall be protected with corner angles.

c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a
layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Flashing sealant shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered with contact adhesive. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Exposed insulation corners shall be protected with corner angles.

d. Insulation on equipment with ribs shall be applied over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer's representative, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating or vapor barrier jacket shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Flashing sealant or vapor barrier tape shall be applied to parting line between equipment and removable section insulation.

-- End of Section --
PART 1   GENERAL

1.1   EXISTING SYSTEM

A. The existing system is a Siemens DDC system which is to be modified and
expanded by Siemens to accomplish the new control sequences shown on the
drawings, which includes modifications to the existing control sequences
shown on the drawings. Programming code and graphics are both to be
modified to include new control sequences and equipment, and to show any
revisions to existing equipment or systems and their associated graphics.
The scope of this project includes testing existing and new control work.
Existing DDC system is manufactured by Siemens Industry, Inc. Building
Technologies.

B. The server and operator workstation are located at Buildings 260 and
62. Upgrade the existing server, operator workstation, and laptop computer
software with the manufacturer's latest software version for all used
applications. Upgrade hardware, memory, and operating systems if required.

C. Provide new and modify existing DDC systems and non-DDC controls
including associated equipment and accessories. All new devices and
configurations shall be compatible with existing system except where
indicated.

1.2   REFERENCES

The publications listed below form a part of this specification to the
extent referenced. The publications are referred to in the text by the
basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 135 (2012; Errata 2013; INT 1-5 2013; Errata
2013) BACnet—A Data Communication Protocol
for Building Automation and Control Networks

ASME INTERNATIONAL (ASME)

ASME B16.5 (2013) Pipe Flanges and Flanged Fittings:
NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B31.1 (2014; INT 1-47) Power Piping

ASME B40.100 (2013) Pressure Gauges and Gauge
Attachments

ASTM INTERNATIONAL (ASTM)

Gray Iron Castings for Valves, Flanges,
and Pipe Fittings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


IEEE C62.45 (2002; R 2008) Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less)AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1449 (2014) Surge Protective Devices

UL 506 (2008; Reprint Oct 2013) Specialty Transformers

UL 508A (2001; Reprint Feb 2010) Industrial Control Panels


1.3 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC DESCRIPTION

a. Provide new BACnet and modify existing DDC systems including associated equipment and accessories. All new devices are accessible using a Web browser interface and communicate using ASHRAE 135 BACnet communications without the use of gateways, unless gateways are shown on the design drawings and specifically requested by the Contracting Officer. Where gateways are allowed, they must support ASHRAE 135, including all object properties and read-write services shown on Government approved interoperability schedules. Manufacturer's products, including design, materials, fabrication, assembly, inspection, and testing shall be in accordance with ASHRAE 135, ASME B31.1, and NFPA 70, except where indicated otherwise.

b. The existing DDC system is manufactured by Siemens Industry, Inc. Building Technologies. The server and operator workstation for the Energy Management and Control System (EMCS) are located at Buildings 260 and 62. Upgrade the existing server, operator workstation, and laptop computer software with the manufacturer's latest software version for all used applications. Upgrade hardware, memory, and operating systems if required.
1.3.1 Design Requirements

1.3.1.1 Control System Drawings Title Sheet

Provide a title sheet for the control system drawing set. Include the project title, project location, contract number, the controls contractor preparing the drawings, an index of the control drawings in the set, and a legend of the symbols and abbreviations used throughout the control system drawings.

1.3.1.2 List of I/O Points

Also known as a Point Schedule, provide for each input and output point physically connected to a digital controller: point name, point description, point type (Analog Output (AO), Analog Input (AI), Binary Output (BO), Binary Input (BI)), point sensor range, point actuator range, point address, BACnet object, associated BIBBS (where applicable), and point connection terminal number. Typical schedules for multiple identical equipment are allowed unless otherwise requested in design or contract criteria.

1.3.1.3 Control System Components List

Provide a complete list of control system components installed on this project. Include for each controller and device: control system schematic name, control system schematic designation, device description, manufacturer, and manufacturer part number. For sensors, include point name, sensor range, and operating limits. For valves, include body style, Cv, design flow rate, pressure drop, valve characteristic (linear or equal percentage), and pipe connection size. For actuators, include point name, spring or non-spring return, modulating or two-position action, normal (power fail) position, nominal control signal operating range (0-10 volts DC or 4-20 milliamps), and operating limits.

1.3.1.4 Control System Schematics

Provide control system schematics. Typical schematics for multiple identical equipment are allowed unless otherwise requested in design or contract criteria. Include the following:

a. Location of each input and output device

b. Flow diagram for each piece of HVAC equipment

c. Name or symbol for each control system component, such as V-1 for a valve

d. Setpoints, with differential or proportional band values

e. Written sequence of operation for the HVAC equipment

f. Valve and Damper Schedules, with normal (power fail) position

1.3.1.5 HVAC Equipment Electrical Ladder Diagrams

Provide HVAC equipment electrical ladder diagrams. Indicate required electrical interlocks.
1.3.1.6 Component Wiring Diagrams

Provide a wiring diagram for each type of input device and output device. Indicate how each device is wired and powered, showing typical connections at the digital controller and power supply. Show for all field connected devices such as control relays, motor starters, actuators, sensors, and transmitters.

1.3.1.7 Terminal Strip Diagrams

Provide a diagram of each terminal strip. Indicate the terminal strip location, termination numbers, and associated point names.

1.3.1.8 BACnet Communication Architecture Schematic

Provide a schematic showing the project's entire BACnet communication network, including addressing used for LANs, LAN devices including routers and bridges, gateways, controllers, workstations, and field interface devices. If applicable, show connection to existing networks.

1.4 SUBMITTALS

Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item listed, that clearly show compliance with the project specifications.

Government approval is required for all submittals. Submit the following according to 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Include the following in the project's control system drawing set:

Control system drawings title sheet
List of I/O Points
Control System Components List
Control system schematics
HVAC Equipment Electrical Ladder diagrams
Component wiring diagrams
Terminal strip diagrams
BACnet communication architecture schematic

SD-03 Product Data

Direct Digital Controllers
Include BACnet PICS for each controller/device type, including smart sensors (B-SS) and smart actuators (B-SA).

Sensors and Input Hardware

Output Hardware

Surge and transient protection
Indicators
Variable frequency (motor) drives

SD-06 Test Reports
Performance Verification Testing Report

SD-09 Manufacturer's Field Reports
Pre-PVT Checklist

SD-10 Operation and Maintenance Data

BACnet Direct Digital Control Systems

1.5 QUALITY ASSURANCE

1.5.1 Standard Products

Provide material and equipment that are standard manufacturer's products currently in production and supported by a local service organization.

1.5.2 Delivery, Storage, and Handling

Handle, store, and protect equipment and materials to prevent damage before and during installation according to manufacturer's recommendations, and as approved by the Contracting Officer's representative. Replace damaged or defective items.

1.5.3 Operating Environment

Protect components from humidity and temperature variation, dust, and contaminants. If components are stored before installation, keep them within the manufacturer's limits.

1.5.4 Verification of Dimensions

The contractor shall verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing work.

1.5.5 Modification of References

The advisory provisions in ASME B31.1 and NFPA 70 are mandatory. Substitute "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 DDC SYSTEM

a. Provide a networked DDC system for stand-alone control in compliance with the latest revision of the ASHRAE 135 BACnet standard. Include all programming, objects, and services required to meet the sequence of control.
2.1.1 Direct Digital Controllers

Direct digital controllers shall be UL 916 rated.

2.1.1.1 I/O Point Limitation

The total number of I/O hardware points used by a single stand-alone digital controller, including I/O expansion units, shall not exceed 64, except for complex individual equipment or systems. Place I/O expansion units in the same cabinet as the digital controller.

2.1.1.2 Environmental Limits

Controllers shall be suitable for, or placed in protective enclosures suitable for the environment (temperature, humidity, dust, and vibration) where they are located.

2.1.1.3 Stand-Alone Control

Provide stand-alone digital controllers.

2.1.1.4 Internal Clock

Provide internal clocks for all BACnet Building Controllers (B-BC) and BACnet Advanced Application Controllers (B-AAC) using BACnet time synchronization services. Automatically synchronize system clocks daily from an operator-designated controller. The system shall automatically adjust for daylight saving time.

2.1.1.5 Memory

Provide sufficient memory for each controller to support the required control, communication, trends, alarms, and messages. Protect programs residing in memory with EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply). The backup power source shall have capacity to maintain the memory during a 72-hour continuous power outage. Rechargeable power sources shall be constantly charged while the controller is operating under normal line power. Batteries shall be replaceable without soldering. Trend and alarm history collected during normal operation shall not be lost during power outages less than 72 hours long.

2.1.1.6 Immunity to Power Fluctuations

Controllers shall operate at 90 percent to 110 percent nominal voltage rating.

2.1.1.7 Transformer

The controller power supply shall be fused or current limiting and rated at 125 percent power consumption.

2.1.1.8 Wiring Terminations

Use screw terminal wiring terminations for all field-installed controllers. Provide field-removable modular terminal strip or a termination card connected by a ribbon cable for all controllers other than terminal units.
2.1.1.9 Input and Output Interface

Provide hard-wired input and output interface for all controllers as follows:

a. Protection: Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with sources up to 24 volts AC or DC for any duration shall cause no controller damage.

b. Binary Inputs: Binary inputs shall have a toggle switch and monitor on and off contacts from a "dry" remote device without external power, and external 5-24 VDC voltage inputs.

c. Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to binary input requirements and accumulate pulses at a resolution suitable to the application.

d. Analog Inputs: Analog inputs shall monitor low-voltage (0-10 VDC), current (4-20 mA), or resistance (thermistor or RTD) signals.

e. Binary Outputs: Binary outputs shall have a toggle switch and send a pulsed 24 VDC low-voltage signal for modulation control, or provide a maintained open-closed position for on-off control. For HVAC equipment and plant controllers, provide for manual overrides, either with three-position (on-off-auto) override switches and status lights, or with an adjacent operator display and interface. Where appropriate, provide a method to select normally open or normally closed operation.

f. Analog Outputs: Analog outputs shall send modulating 0-10 VDC or 4-20 mA signals to control output devices.

g. Tri-State Outputs: Tri-State outputs shall provide three-point floating control of terminal unit electronic actuators.

2.1.1.10 Digital Controller BACnet Internetwork

Provide a BACnet internetwork with control products, communication media, connectors, repeaters, hubs, and routers. Provide intermediate gateways, only when requested by the Contracting Officer and shown on the contract drawings, to connect existing non-BACnet devices to the BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE 135, BACnet. If a controller becomes non-responsive, the remaining controllers shall continue operating and not be affected by the failed controller.

2.1.1.11 Communications Ports

a. Direct-Connect Interface Ports: Provide at least one extra communication port at each local BACnet network for direct connecting a notebook computer or BACnet hand-held terminal so all network BACnet objects and properties may be viewed and edited by the operator.

2.1.1.12 Digital Controller Cabinet

Provide each digital controller in a factory fabricated cabinet enclosure.
Cabinets located indoors shall protect against dust and have a minimum NEMA 1 rating, except where indicated otherwise. Cabinets located outdoors or in damp environments shall protect against all outdoor conditions and have a minimum NEMA 4 rating. Outdoor control panels and controllers must be able to withstand extreme ambient conditions, without malfunction or failure, whether or not the controlled equipment is running. If necessary, provide a thermostatically controlled panel heater in freezing locations, and an internal ventilating fan in locations exposed to direct sunlight. Cabinets shall have a hinged lockable door and an offset removable metal back plate, except controllers integral with terminal units, like those mounted on VAV boxes. Provide like-keyed locks for all hinged panels provided and a set of two keys at each panel, with one key inserted in the lock.

2.1.1.13 Main Power Switch and Receptacle

Provide each control cabinet with a main external power on/off switch located inside the cabinet. Also provide each cabinet with a separate 120 VAC duplex receptacle.

2.1.2 DDC Software

2.1.2.1 Programming

Provide programming to execute the sequence of operation indicated. Provide all programming and tools to configure and program all controllers. Provide programming routines in simple, easy-to-follow logic with detailed text comments describing what the logic does and how it corresponds to the project's written sequence of operation.

2.1.2.2 Parameter Modification

All writeable object properties, and all other programming parameters needed to comply with the project specification shall be adjustable for devices at any network level, including those accessible with web-browser communication, and regardless of programming methods used to create the applications.

2.1.2.3 Short Cycling Prevention

Provide setpoint differentials and minimum on/off times to prevent equipment short cycling.

2.1.2.4 Equipment Status Delay

Provide an adjustable delay from when equipment is commanded on or off and when the control program looks to the status input for confirmation.

2.1.2.5 Timed Local Override

Provide an adjustable override time for each push of a timed local override button.

2.1.2.6 Time Synchronization

Provide time synchronization, including adjustments for leap years, daylight saving time, and operator time adjustments.
2.1.2.7 Scheduling

Provide operating schedules as indicated, with equipment assigned to groups. Changing the schedule of a group shall change the operating schedule of all equipment in the group. Groups shall be capable of operator creation, modification, and deletion. Provide capability to view and modify schedules in a seven-day week format. Provide capability to enter holiday and override schedules one full year at a time.

2.1.2.8 Object Property Override

Allow writeable object property values to accept overrides to any valid value. Where specified or required for the sequence of control, the Out-Of-Service property of Objects shall be modifiable using BACnet's write property service. When documented, exceptions to these requirements are allowed for life, machine, and process safety.

2.1.2.9 Alarms and Events

Alarms and events shall be capable of having programmed time delays and high-low limits. When a computer workstation or web server is connected to the BACnet internetwork, alarms/events shall report to the computer, printer, as defined by an authorized operator. Otherwise alarms/events shall be stored within a device on the BACnet network until connected to a user interface device and retrieved. Provide alarms/events in agreement with the point schedule, sequence of operation, and the BAS Owner. At a minimum, provide programming to initiate alarms/events any time a piece of equipment fails to operate, a control point is outside normal range or condition shown on schedules, communication to a device is lost, a device has failed, or a controller has lost its memory.

2.1.2.10 Trending

Provide BACnet trend services capable of trending all object present values set points, and other parameters indicated for trending on project schedules. Trends may be associated into groups, and a trend report may be set up for each group. Trends are stored within a device on the BACnet network, with operator selectable trend intervals from 10 seconds up to 60 minutes. The minimum number of consecutive trend values stored at one time shall be 100 per variable. When trend memory is full, the most recent data shall overwrite the oldest data.

The operator workstation shall upload trends automatically upon reaching 3/4 of the device buffer limit (via Notification_Threshold property), by operator request, or by time schedule for archiving. Archived and real-time trend data shall be available for viewing numerically and graphically for at the workstation and connected notebook computers.

2.1.2.11 Power Loss

Upon restoration of power, the DDC system shall perform an orderly restart and restoration of control.

2.1.3 BACnet Operator Workstation

The workstation shall be capable of accessing all DDC system devices and communicate using the BACnet protocol. The workstation shall be capable of displaying, modifying, creating, archiving, and deleting (as applicable): all points, objects, object properties, programming, alarms, trends,
messages, schedules, and reports.

2.1.3.1 Graphics Software

Provide updated system graphics to display new work under this contract.

HVAC Equipment: Update as necessary graphic display for each piece of HVAC equipment, such as a fan coil unit, VAV terminal, or air handling unit. Equipment shall be represented by a two or three-dimensional drawing. Where multiple pieces of equipment combine to form a system, such as a central chiller plant or central heating plant, provide one graphic to depict the entire plant. Indicate the equipment, piping, ductwork, dampers, and control valves in the installed location. Include labels for equipment, piping, ductwork, dampers, and control valves. Show the direction of air and water flow. Include dynamic display of applicable object data with clear names in appropriate locations.

b. Graphic Title: Provide a prominent, descriptive title on each graphic page.

c. Dynamic Update: When the workstation is on-line, all graphic I/O object values shall update with change-of-value services, or by operator selected discrete intervals.

d. Graphic Linking: Provide forward and backward linking between floor plans, sub-plans, and equipment.

f. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on the graphics.

2.2 SENSORS AND INPUT HARDWARE

Coordinate sensor types with the BAS Owner to keep them consistent with existing installations.

2.2.1 Field-Installed Temperature Sensors

Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.

2.2.1.1 Thermistors

Precision thermistors may be used in applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degrees F cumulative. A/D conversion resolution error shall be kept to 0.1 degrees F. Total error for a thermistor circuit shall not exceed 0.5 degrees F.

2.2.1.2 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with platinum elements compatible with the digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degrees F.
cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25 degrees F. The total error for a RTD circuit shall not exceed 0.5 degrees F.

2.2.1.3 Temperature Sensor Details

a. Room Type: Provide the sensing element components within a decorative protective cover suitable for surrounding decor. Provide room temperature sensors with digital temperature display.

b. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.

c. Duct Averaging Type: Continuous averaging sensors shall be one foot in length for each 4 square feet of duct cross-sectional area, and a minimum length of 6 feet.

d. Pipe Immersion Type: Provide minimum three-inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel when used in steel piping, and brass when used in copper piping. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior.

e. Outside Air Type: Provide the sensing element on the building's north side with a protective weather shade that positions the sensor approximately 3 inches off the wall surface, does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain.

2.2.2 Transmitters

Provide transmitters with 4 to 20 mA or 0 to 10 VDC linear output scaled to the sensed input. Transmitters shall be matched to the respective sensor, factory calibrated, and sealed. Size transmitters for an output near 50 percent of its full-scale range at normal operating conditions. The total transmitter error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 12 to 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter drift shall not exceed 0.03 degrees F a year.

2.2.2.1 Relative Humidity Transmitters

Provide transmitters with an accuracy equal to plus or minus 5 percent from 0 to 90 percent scale, and less than one percent drift per year. Sensing elements shall be the polymer type.

2.2.2.2 Pressure Transmitters

Provide transmitters integral with the pressure transducer.

2.2.3 Current Transducers

Provide current transducers to monitor motor amperage, unless current switches are shown on design drawings or point tables.
2.2.4 Pneumatic to Electric Transducers

Pneumatic to electronic transducers shall convert a 0 to 20 psig signal to a proportional 4 to 20 mA or 0 to 10 VDC signal (operator scaleable). Supply voltage shall be 24 VDC. Accuracy and linearity shall be 1.0 percent or better.

2.2.5 Air Quality Sensors

Provide power supply for each sensor.

2.2.5.1 CO2 Sensors

Provide photo-acoustic type CO2 sensors with integral transducers and linear output. The devices shall read CO2 concentrations between 0 and 2000 ppm with full scale accuracy of at least plus or minus 100 ppm.

2.2.6 Input Switches

2.2.6.1 Timed Local Overrides

Provide buttons or switches to override the DDC occupancy schedule programming for each major building zone during unoccupied periods, and to return HVAC equipment to the occupied mode. This requirement is waived for zones clearly intended for 24 hour continuous operation.

2.2.6.2 Freeze Protection Thermostats

Provide special purpose thermostats with flexible capillary elements 20 feet minimum length for coil face areas up to 40 square feet. Provide longer elements for larger coils at 1-foot of element for every 4 square feet of coil face area, or provide additional thermostats. Provide switch contacts rated for the respective motor starter's control circuit voltage. Include auxiliary contacts for the switch's status condition. A freezing condition at any 18-inch increment along the sensing element's length shall activate the switch. The thermostat shall be equipped with a manual push-button reset switch so that when tripped, the thermostat requires manual resetting before the HVAC equipment can restart.

2.2.7 Air Flow Measurement Stations

Air flow measurement stations shall have an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be the RTD or thermistor type, traversing the ducted air in at least two directions. The air flow pressure drop across the station shall not exceed 0.08 inch water gage at a velocity of 2,000 fpm. The station shall be suitable for air flows up to 5,000 fpm, and a temperature range of 40 to 120 degrees F. The station's measurement accuracy over the range of 125 to 2,500 fpm shall be plus or minus 3 percent of the measured velocity. Station transmitters shall provide a linear, temperature-compensated 4 to 20 mA or 0 to 10 VDC output. The output shall be capable of being accurately converted to a corresponding air flow rate in cubic feet per minute. Transmitters shall be a 2-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the measurement.
2.3 OUTPUT HARDWARE

2.3.1 Control Valves

2.3.1.1 Valve Assembly

Valve bodies shall be designed for 125 psig minimum working pressure or 150 percent of the operating pressure, whichever is greater. Valve stems shall be Type 316 stainless steel. Valve leakage ratings shall be 0.01 percent of rated Cv value. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall meet the requirements of ASME B16.5. Cast iron valve components shall meet the requirements of ASTM A126 Class B or C.

2.3.1.2 Two-Way Valves

Two-way modulating valves shall have an equal percentage characteristic.

2.3.1.3 Three-Way Valves

Three-way valves shall have an equal percentage characteristic.

2.3.1.4 Valves for Chilled Water, Condenser Water, and Glycol Fluid Service

a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for 2 inch valves shall have threaded connections. Bodies for valves from 2-1/2 to 3 inches shall have flanged connections.

b. Internal valve trim shall be brass or bronze, except that valve stems shall be stainless steel.

c. Unless indicated otherwise, provide modulating valves sized for 2 psi minimum and 4 psi maximum differential across the valve at the design flow rate.

2.3.1.5 Valves for Hot Water Service

Valves for hot water service below 250 Degrees F:

a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for 2 inch valves shall have threaded connections. Bodies for valves from 2-1/2 to 3 inches shall have flanged connections.

b. Internal trim (including seats, seat rings, modulation plugs, valve stems, and springs) of valves controlling water above 210 degrees F shall be Type 316 stainless steel.

c. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Valve stems shall be Type 316 stainless steel.

d. Non-metallic parts of hot water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher.
e. Unless indicated otherwise, provide modulating valves sized for 2 psi minimum and 4 psi maximum differential across the valve at the design flow rate.

2.3.2 Actuators

Provide direct-drive electric actuators for all control applications, except where indicated otherwise.

2.3.2.1 Electric Actuators

Each actuator shall deliver the torque required for continuous uniform motion and shall have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Actuators shall function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds. Provide two-position actuators of single direction, spring return, or reversing type. Provide modulating actuators capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Thermal type actuators may only be used on terminal fan coil units, terminal VAV units, convectors, and unit heaters. Spring return actuators shall be provided on all control dampers and all control valves except terminal fan coil units, terminal VAV units, convectors, and unit heaters; unless indicated otherwise. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.

2.3.3 Output Switches

2.3.3.1 Control Relays

Field installed and DDC panel relays shall be double pole, double throw, UL listed, with contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light shall be lit when the coil is energized and off when coil is not energized. Relays shall be the socket type, plug into a fixed base, and replaceable without tools or removing wiring. Encapsulated "PAM" type relays may be used for terminal control applications.

2.4 ELECTRICAL POWER AND DISTRIBUTION

2.4.1 Transformers

Transformers shall conform to UL 506. For control power other than terminal level equipment, provide a fuse or circuit breaker on the secondary side of each transformer.

2.4.2 Surge and Transient Protection

Provide each digital controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.
2.4.2.1 Power Line Surge Protection

Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following:

a. The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.

b. The device shall react within 5 nanoseconds and automatically reset.

c. The voltage protection threshold, line to neutral, shall be no more than 211 volts.

d. The device shall have an independent secondary stage equal to or greater than the primary stage joule rating.

e. The primary suppression system components shall be pure silicon avalanche diodes.

f. The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.

g. The device shall have an indication light to indicate the protection components are functioning.

h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.

i. The device shall have an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.

j. The device shall comply with IEEE C62.41.1 and IEEE C62.41.2, Class "B" requirements and be tested according to IEEE C62.45.

k. The device shall be capable of operating between minus 20 degrees F and plus 122 degrees F.

2.4.2.2 Telephone and Communication Line Surge Protection

Provide surge and transient protection for DDC controllers and DDC network related devices connected to phone and network communication lines, in accordance with the following:

a. The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges.

b. The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology.

c. The device shall be installed at the distance recommended by its manufacturer.

2.4.2.3 Controller Input/Output Protection

Provide controller inputs and outputs with surge protection via optical
isolation, metal oxide varistors (MOV), or silicon avalanche devices.
Fuses are not permitted for surge protection.

2.4.3 Wiring

Provide complete electrical wiring for the DDC System, including wiring to transformer primaries. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring in conduit. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, above suspended ceilings, in attics, and within ductwork.

2.4.3.1 Power Wiring

The following requirements are for field-installed wiring:

a. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.

b. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.

2.4.3.2 Analog Signal Wiring

Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

2.5 INDICATORS

2.5.1 Thermometers

Provide bi-metal type thermometers at locations shown. Thermometers shall have either 9 inch long scales or 3.5 inch diameter dials, with insertion, immersion, or averaging elements. Provide matching thermowells for pipe-mounted installations. Select scale ranges suitable for the intended service, with the normal operating temperature near the scale's midpoint. The thermometer's accuracy shall be plus or minus 2 percent of the scale range.

2.5.2 Pressure Gauges for Piping Systems

Provide pipe-mounted pressure gauges at the locations shown. Gauges shall conform to ASME B40.100 and have a 4-inch diameter dial and shutoff cock. Provide gauges in steam piping with a pressure snubber pigtail fitting. Select scale ranges suitable for the intended service, with the normal operating pressure near the scale's midpoint. The gauge's accuracy shall be plus or minus 2 percent of the scale range.

2.6 VARIABLE FREQUENCY (MOTOR) DRIVES

Provide variable frequency drives (VFDs) as indicated. VFDs shall convert
240 or 460 volt (plus or minus 10 percent), three phase, 60 hertz (plus or minus 2Hz), utility grade power to adjustable voltage/frequency, three phase, AC power for stepless motor control from 5 percent to 105 percent of base speed. VFDs shall be UL listed as delivered to the end user. The VFD shall meet the requirements specified in the most current National Electrical Code. Each VFD shall also meet the following:

a. The VFD shall use sine coded Pulse Width Modulation (PWM) technology. PWM calculations shall be performed by the VFD microprocessor.

b. The VFD shall be capable of automatic control by a remote 4-20 mA or 0 to 10 VDC signal, by network command, or manually by the VFD control panel.

2.6.1 VFD Quality Assurance

VFDs shall be the manufacturer's current standard production unit with at least 10 identical units successfully operating in the field.

2.6.2 VFD Service Support

a. Warranty: Provide the VFDs with a minimum 24-month full parts and labor warranty. The warranty shall start when the contract's HVAC system is accepted by the Contracting Officer. Include warranty documentation, dates, and contact information with the VFD on-site service manuals.

b. VFD Service Manuals: Provide the VFDs with all necessary installation, operation, maintenance, troubleshooting, service, and repair manuals in English including related factory technical bulletins. Provide the documents factory bound, in sturdy 3-ring binders, or hard bound covers. Provide a title sheet on the outside of each binder indicating the project title, project location, installing contractor, contract number, and the VFD manufacturer, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. The documentation provided shall be specifically applicable to this project, shall be annotated to reflect the actual project conditions, and shall provide a complete and concise depiction of the installed work.

c. Technical Support: Provide the VFDs with manufacturer's technical telephone support in English, readily available during normal working hours, and free of charge for the life of the equipment.

d. Initial Start-Up: Provide the VFDs with factory-trained personnel for the on-site start-up of the HVAC equipment and associated VFD. The personnel shall be competent in the complete start-up, operation, and repair of the particular model VFD installed. The factory start-up representative shall perform the factory's complete recommended start-up procedures and check-out tests on the VFD. Include a copy of the start-up test documentation with the VFD on-site service manuals.

e. Provide the VFDs with on-site/hands-on training for the user and maintenance personnel. Provide a capable and qualified instructor with minimum two years field experience with the operation and maintenance of similar VFDs. The training shall occur during normal working hours and last not less than 2 hours. Coordinate the training time with the Contracting Officer's representative and the end user. The VFD service manuals shall be used during the training. The contractor shall ensure
the manuals are on-site before the start of training. The training shall cover all operational aspects of the VFD.

2.6.3 VFD Features

VFDs shall have the following features:

a. A local operator control keypad capable of:

   (1) Remote/Local operator selection with password access.
   (2) Run/Stop and manual speed commands.
   (3) All programming functions.
   (4) Scrolling through all display functions.

b. Digital display capable of indicating:

   (1) VFD status.
   (2) Frequency.
   (3) Motor RPM.
   (4) Phase current.
   (5) Fault diagnostics in descriptive text.
   (6) All programmed parameters.

c. Standard PI loop controller with input terminal for controlled variable and parameter settings.

d. User interface terminals for remote control of VFD speed, speed feedback, and an isolated form C SPDT relay, which energizes on a drive fault condition.

e. An isolated form C SPDT auxiliary relay which energizes on a run command.

f. A metal NEMA 1 enclosure for indoors, NEMA 4 with heater for outdoors.

g. An adjustable carrier frequency with 16 KHz minimum upper limit.

h. A built in or external line reactor with 3 percent minimum impedance to protect the VFDs DC buss capacitors and rectifier section diodes.

2.6.4 Programmable Parameters

VFDs shall include the following operator programmable parameters:

a. Upper and lower limit frequency.

b. Acceleration and Deceleration rate.

c. Variable torque volts per Hertz curve.

d. Starting voltage level.
e. Starting frequency level.
f. Display speed scaling.
g. Enable/disable auto-restart feature.
h. Enable/disable soft stall feature.
i. Motor overload level.
j. Motor stall level.
k. Jump frequency and hysteresis band.
l. PWM carrier frequency.

2.6.5 Protective Features

VFDs shall have the following protective features:

a. An electronic adjustable inverse time current limit with consideration for additional heating of the motor at frequencies below 45Hz, for the protection of the motor.

b. An electronic adjustable soft stall feature, allowing the VFD to lower the frequency to a point where the motor will not exceed the full-load amperage when an overload condition exists at the requested frequency. The VFD will automatically return to the requested frequency when load conditions permit.

c. A separate electronic stall at 110 percent VFD rated current, and a separate hardware trip at 190 percent current.

d. Ground fault protection that protects the output cables and motor from grounds during both starting and continuous running conditions.

e. The ability to restart after the following faults:

(1) Overcurrent (drive or motor).
(2) Power outage.
(3) Phase loss.
(4) Over voltage/Under voltage.

f. The ability shut down if inadvertently started into a rotating load without damaging the VFD or the motor.

g. The ability to keep a log of a minimum of four previous fault conditions, indicating the fault type and time of occurrence in descriptive text.

h. The ability to sustain 110 percent rated current for 60 seconds

i. The ability to shutdown safely or protect against and record the following fault conditions:
(1) Over current (and an indication if the over current was during acceleration, deceleration, or running).

(2) Over current internal to the drive.

(3) Motor overload at start-up.

(4) Over voltage from utility power.

(5) Motor running overload.

(6) Over voltage during deceleration.

(7) VFD over heat.

(8) Load end ground fault.

(9) Abnormal parameters or data in VFD EEPROM.

2.6.6 Minimum Operating Conditions

VFDs shall be designed and constructed to operate within the following service conditions:

a. Ambient Temperature Range, 0 to 120 degrees F.

b. Non-condensing relative humidity to 90 percent.

2.6.7 Additional Features

Provide VFDs with the following additional features:

a. RFI/EMI filters

b. Manual bypass circuit and switch integral to the drive to allow drive bypass and operation at 100 percent speed. Motor overload and short circuit protective features shall remain in use during the bypass mode.

PART 3 EXECUTION

3.1 INSTALLATION

Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1 BACnet Naming and Addressing

Coordinate with the BAS Owner and provide unique naming and addressing for BACnet networks and devices.

3.1.2 Minimum BACnet Object Requirements

a. Use of Standard BACnet Objects

For the following points and parameters, use standard BACnet objects, where all relevant object properties can be read using BACnet's Read Property Service, and all relevant object properties can be modified using BACnet's Write Property Service:

all device physical inputs and outputs, all set points, all PID tuning
parameters, all calculated pressures, flow rates, and consumption values, all alarms, all trends, all schedules, and all equipment and lighting circuit operating status.

b. BACnet Object Description Property

The Object Description property shall support 32 minimum printable characters. For each object, complete the description property field using a brief, narrative, plain English description specific to the object and project application. For example: "HW Pump 1 Proof." Document compliance, length restrictions, and whether the description is writeable in the device PICS.

c. Analog Input, Output, and Value Objects

Support and provide Description and/or Device_Type text strings matching signal type and engineering units shown on the points list.

d. Binary Input, Output, and Value Objects

Support and provide Inactive_Text and Active_Text property descriptions matching conditions shown on the points list.

e. Calendar Object

For devices with scheduling capability, provide at least one Calendar Object with ten-entry capacity. All operators may view Calendar Objects; authorized operators may make modifications from a workstation. Enable the writeable Date List property and support all calendar entry data types.

f. Schedule Object

Use Schedule Objects for all building system scheduling. All operators may view schedule entries; authorized operators may modify schedules from a workstation.

g. Loop Object or Equal

Use Loop Objects or equivalent BACnet objects in each applicable field device for PID control. Regardless of program method or object used, allow authorized operators to adjust the Update Interval, Setpoint, Proportional Constant, Integral Constant, and Derivative Constant using BACnet read/write services.

3.1.3 Local Area Networks

Obtain COR approval before connecting new networks with existing networks. Network numbers and device instance numbers shall remain unique when joining networks. Do not change existing network addressing without Contracting Officer approval. See also "BACnet Naming and Addressing".

3.1.4 BACnet Routers, Bridges, and Switches

Provide the quantity of BACnet routers, bridges, and switches necessary for communications shown on the BACnet Communication Architecture schematic. Provide BACnet routers with BACnet Broadcast Message Device (BBMD) capability on each BACnet internetwork communicating across an IP network. Configure each BACnet device and bridge, router, or switch to communicate
on its network segment.

3.1.5 Wiring Criteria

a. Run circuits operating at more than 100 volts in rigid or flexible conduit, metallic tubing, covered metal raceways, or armored cable.

b. Do not run binary control circuit wiring in the same conduit as power wiring over 100 volts. Where analog signal wiring requires conduit, do not run in the same conduit with AC power circuits or control circuits operating at more than 100 volts.

c. Provide circuit and wiring protection required by NFPA 70.

d. Run all wiring located inside mechanical rooms in conduit.

e. Do not bury aluminum-sheathed cable or aluminum conduit in concrete.

f. Input/output identification: Permanently label each field-installed wire, cable, and pneumatic tube at each end with descriptive text using a commercial wire marking system that fully encircles the wire, cable, or tube. Locate the markers within 2 inches of each termination. Match the names and I/O number to the project's point list. Similarly label all power wiring serving control devices, including the word "power" in the label. Number each pneumatic tube every six feet. Label all terminal blocks with alpha/numeric labels. All wiring and the wiring methods shall be in accordance with UL 508A.

g. For controller power, provide new 120 VAC circuits, with ground. Provide each circuit with a dedicated breaker, and run wiring in its own conduit, separate from any control wiring. Connect the controller's ground wire to the electrical panel ground; conduit grounds are not acceptable.

h. Surge Protection: Install surge protection according to manufacturer's instructions. Multiple controllers fed from a common power supply may be protected by a common surge protector, properly sized for the total connected devices.

i. Grounding: Ground controllers and cabinets to a good earth ground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit grounding is not acceptable; all grounding shall have a direct path to the building earth ground. Ground sensor drain wire shields at the controller end.

j. The Contractor shall be responsible for correcting all associated ground loop problems.

k. Run wiring in panel enclosures in covered wire track.

3.1.6 Accessibility

Install all equipment so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install digital controllers, data ports, and concealed actuators, valves, dampers, and like equipment in locations freely accessible through access doors.
3.1.7 Digital Controllers

a. Install as stand alone control devices (see definitions).

b. Locate control cabinets at the locations shown on the drawings. If not shown on the drawings, install in the most accessible space, close to the controlled equipment.

3.1.8 Hand-Off-Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

3.1.9 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

3.1.9.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of the sensor 5 feet above the finished floor.

3.1.9.2 Duct Temperature Sensors

a. Probe Type: Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. Seal the duct insulation penetration vapor tight.

b. Averaging Type (and coil freeze protection thermostats): Weave the capillary tube sensing element in a serpentine fashion perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports. Prevent contact between the capillary and the duct or air handler internals. Provide a duct access door at the sensor location. The access door shall be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors shall be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.9.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermal conductivity material within the well to fully coat the inserted sensor.

3.1.9.4 Outside Air Temperature Sensors

Provide outside air temperature sensors in weatherproof enclosures on the north side of the building, away from exhaust hoods and other areas that
may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.10 Damper Actuators

Where possible, mount actuators outside the air stream in accessible areas.

3.1.11 Thermometers and Gages

Mount devices to allow reading while standing on the floor or ground, as applicable.

3.1.12 Pressure Sensors

Locate pressure sensors as indicated.

3.1.13 Component Identification Labeling

Using an electronic hand-held label maker with white tape and bold black block lettering, provide an identification label on the exterior of each new control panel, control device, actuator, and sensor. Also provide labels on the exterior of each new control actuator indicating the (full) open and (full) closed positions. For labels located outdoors, use exterior grade label tape, and provide labels on both the inside and outside of the panel door or device cover. Acceptable alternatives are white plastic labels with engraved bold black block lettering permanently attached to the control panel, control device, actuator, and sensor. Have the labels and wording approved by the BAS Owner prior to installation.

3.2 TEST AND BALANCE SUPPORT

The controls contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel. This support shall include:

a. On-site operation and manipulation of control systems during the testing and balancing.

b. Control setpoint adjustments for balancing all relevant mechanical systems, including VAV boxes.

c. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.3 CONTROLS SYSTEM OPERATORS MANUALS

Provide electronic and printed copies of a Controls System Operators Manual. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.

Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types. When approved by the Contracting Officer, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders.
Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the controls contractor name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:

a. A copy of the as-built control system (shop) drawings set, with all items specified under the paragraph "Submittals." Indicate all field changes and modifications.

b. A copy of the project's mechanical design drawings, including any official modifications and revisions.

c. A copy of the project's approved Product Data submittals provided under the paragraph "Submittals."

d. A copy of the project's approved Performance Verification Testing Plan and Report.

e. A copy of the project's approved final TAB Report.

f. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.

g. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.

h. A table entitled "AC Power Table" listing the electrical power source for each controller. Include the building electrical panel number, panel location, and circuit breaker number.

i. The DDC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation and notebook software.

j. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.

k. A written statement entitled "Technical Support" stating the control system manufacturer or authorized representative will provide toll-free telephone technical support at no additional cost to the Government for a minimum of two years from project acceptance, will be furnished by experienced service technicians, and will be available during normal weekday working hours. Include the toll-free technical support telephone number.

l. A written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request at no additional cost to the Government for a minimum of two years from contract acceptance. Include a table of all DDC system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.
3.4 PERFORMANCE VERIFICATION TESTING (PVT)

3.4.1 General

The PVT shall demonstrate compliance of the control system work with the contract requirements. The PVT shall be performed by the Contractor and witnessed and approved by the Contracting Officer. If the project is phased, provide separate testing for each phase. A Pre-PVT meeting to review the Pre-PVT Checklist is required to coordinate all aspects of the PVT and shall include the Contractor's QA representative, the Contractor's PVT administrator, the Contracting Officer's representative, and the BAS Owner.

3.4.2 Pre-Performance Verification Testing Checklist

Submit the following as a list with items checked off once verified. Provide a detailed explanation for any items that are not completed or verified.

a. Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the PVT is conducted).

b. Verify HVAC motors operate below full-load amperage ratings.

c. Verify all required control system components, wiring, and accessories are installed.

d. Verify the installed control system architecture matches approved drawings.

e. Verify all control circuits operate at the proper voltage and are free from grounds or faults.

f. Verify all required surge protection is installed.

g. Verify the A/C Power Table specified in "CONTROLS SYSTEM OPERATORS MANUALS" is accurate.

h. Verify all DDC network communications function properly, including uploading and downloading programming changes.

i. Using the BACnet protocol analyzer (if provided or required in this specification), verify communications are error free.

j. Verify each digital controller’s programming is backed up.

k. Verify all wiring, components, and panels are properly labeled.

l. Verify all required points are programmed into devices.

m. Verify all TAB work affecting controls is complete.

n. Verify all valve and actuator zero and span adjustments are set properly.

o. Verify all sensor readings are accurate and calibrated.
p. Verify each control valve and actuator goes to normal position upon loss of power.

q. Verify all control loops are tuned for smooth and stable operation. View trend data where applicable.

r. Verify each controller works properly in stand-alone mode.

s. Verify all safety controls and devices function properly, including freeze protection and interfaces with building fire alarm systems.

t. Verify all electrical interlocks work properly.

u. Verify all workstations, notebooks and maintenance personnel interface tools are delivered, all system and database software is installed, and graphic pages are created for each workstation and notebook.

v. Verify the as-built (shop) control drawings are completed.

3.4.3 Conducting Performance Verification Testing

a. Conduct COR-witnessed PVT after approval of the PVT Plan and the completed Pre-PVT Checklist. Notify the Contracting Officer's representative of the planned PVT at least 15 days prior to testing. Provide an estimated time table required to perform the testing. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of the PVT. Ensure that testing personnel are regularly employed in the testing and calibration of DDC systems. Using the project's as-built control system (shop) drawings, the project's mechanical design drawings, the approved Pre-PVT Checklist, and the approved PVT Plan, conduct the PVT.

b. During testing, identify any items that do not meet the contract requirements and if time permits, conduct immediate repairs and re-test. Otherwise, deficiencies shall be investigated, corrected, and re-tested later. Document each deficiency and corrective action taken.

c. If re-testing is required, follow the procedures for the initial PVT. The COR may require re-testing of any control system components affected by the original failed test.

3.4.4 Controller Capability and Labeling

Test the following for each controller:

a. Memory: Demonstrate that programmed data, parameters, and trend/ alarm history collected during normal operation is not lost during power failure.

b. Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a portable electronic device like a notebook computer or PDA. Show that maintenance personnel interface tools perform as specified in the manufacturer's technical literature.

c. Stand Alone Ability: Demonstrate controllers provide stable and reliable stand-alone operation using default values or other method for values normally read over the network.
d. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the BACnet Communication Architecture Schematic and floor plans.

e. Nameplates and Tags: Show the nameplates and tags are accurate and permanently attached to control panel doors, devices, sensors, and actuators.

3.4.5 Workstation and Software Operation

For every user workstation or notebook provided:

a. Show points lists agree with naming conventions.

b. Show that graphics are complete.

c. Show the UPS operates as specified.

3.4.6 BACnet Communications and Interoperability Areas

Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. If available or required in this specification, use a BACnet protocol analyzer to assist with identifying devices, viewing network traffic, and verifying interoperability. These requirements must be met even if there is only one manufacturer of equipment installed. Testing includes the following:

a. Data Presentation: On each BACnet Operator Workstation, demonstrate graphic display capabilities.

b. Reading of Any Property: Demonstrate the ability to read and display any used readable object property of any device on the network.

c. Setpoint and Parameter Modifications: Show the ability to modify all setpoints and tuning parameters in the sequence of control or listed on project schedules. Modifications are made with BACnet messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.

d. Peer-to-Peer Data Exchange: Show all BACnet devices are installed and configured to perform BACnet read/write services directly (without the need for operator or workstation intervention), to implement the project sequence of operation, and to share global data.

e. Alarm and Event Management: Show that alarms/events are installed and prioritized according to the BAS Owner. Demonstrate time delays and other logic is set up to avoid nuisance tripping, e.g., no status alarms during unoccupied times or high supply air during cold morning start-up. Show that operators with sufficient privilege can read and write alarm/event parameters for all standard BACnet event types. Show that operators with sufficient privilege can change routing (BACnet notification classes) for each alarm/event including the destination, priority, day of week, time of day, and the type of transition involved (TO-OFF NORMAL, TO-NORMAL, etc.).

f. Schedule Lists: Show that schedules are configured for start/stop, mode change, occupant overrides, and night setback as defined in the
sequence of operations.

g. Schedule Display and Modification: Show the ability to display any schedule with start and stop times for the calendar year. Show that all calendar entries and schedules are modifiable from any connected workstation by an operator with sufficient privilege.

h. Archival Storage of Data: Show that dataarchiving is handled by the operator workstation/server, and local trend archiving and display is accomplished with BACnet Trend Log objects.

i. Modification of Trend Log Object Parameters: Show that an operator with sufficient privilege can change the logged data points, sampling rate, and trend duration.

j. Device and Network Management: Show the following capabilities:

   (1) Display of Device Status Information
   (2) Display of BACnet Object Information
   (3) Silencing Devices that are Transmitting Erroneous Data
   (4) Time Synchronization
   (5) Remote Device Reinitialization
   (6) Backup and Restore Device Programming and Master Database(s)
   (7) Configuration Management of Half-Routers, Routers and BBMDs

3.4.7 Execution of Sequence of Operation

Demonstrate that the HVAC system operates properly through the complete sequence of operation. Use read/write property services to globally read and modify parameters over the internetwork.

3.4.8 Control Loop Stability and Accuracy

For all control loops tested, give the COR trend graphs of the control variable over time, demonstrating that the control loop responds to a 20 percent sudden change of the control variable set point without excessive overshoot and undershoot. If the process does not allow a 20 percent set point change, use the largest change possible. Show that once the new set point is reached, it is stable and maintained. Control loop trend data shall be in real-time with the time between data points 30 seconds or less.

3.4.9 Performance Verification Testing Report

Upon successful completion of the PVT, submit a PVT Report to the Contracting Officer and prior to the Government taking use and possession of the facility. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated PVT Plan used during the PVT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements.
3.5 TRAINING REQUIREMENTS

Provide a qualified instructor (or instructors) with two years minimum field experience with the installation and programming of similar BACnet DDC systems. Orient training to the specific systems installed. Coordinate training times with the Contracting Officer's representative and BAS Owner after receiving approval of the training course documentation. Training shall take place at the job site and/or a nearby Government-furnished location. A training day shall occur during normal working hours, last no longer than 8 hours and include a one-hour break for lunch and two additional 15-minute breaks. The project's approved Controls System Operators Manual shall be used as the training text. The Contractor shall ensure the manuals are submitted, approved, and available to hand out to the trainees before the start of training.

3.5.1 Training Documentation

Submit training documentation for review 30 days minimum before training. Documentation shall include an agenda for each training day, objectives, a synopses of each lesson, and the instructor's background and qualifications. The training documentation can be submitted at the same time as the project's Controls System Operators Manual.

3.5.2 Phase I Training - Fundamentals

The Phase I training session shall last 2 hours and be conducted in a classroom environment with complete audio-visual aids provided by the contractor. Provide each trainee a printed 8.5 by 11 inch hard-copy of all visual aids used. Upon completion of the Phase I Training, each trainee should fully understand the project's DDC system fundamentals. The training session shall include the following:

a. BACnet fundamentals (objects, services, addressing) and how/where they are used on this project
b. This project's list of control system components
c. This project's list of points and objects
d. This project's device and network communication architecture
e. This project's sequences of control, and:
f. Alarm capabilities
g. Trending capabilities
h. Troubleshooting communication errors
i. Troubleshooting hardware errors

3.5.3 Phase II Training - Operation

Provide Phase II Training shortly after completing Phase I Training. The Phase II training session shall last 4 hours and be conducted at the DDC system workstation, at a notebook computer connected to the DDC system in the field, and at other site locations as necessary. Upon completion of the Phase II Training, each trainee should fully understand the project's DDC system operation. The training session shall include the following:
a. A walk-through tour of the mechanical system and the installed DDC components (controllers, valves, dampers, surge protection, switches, thermostats, sensors, etc.)

b. A discussion of the components and functions at each DDC panel

c. Logging-in and navigating at each operator interface type

d. Using each operator interface to find, read, and write to specific controllers and objects

e. Modifying and downloading control program changes

f. Modifying setpoints

g. Creating, editing, and viewing trends

h. Creating, editing, and viewing alarms

i. Creating, editing, and viewing operating schedules and schedule objects

j. Backing-up and restoring programming and data bases

k. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics

l. Creating new graphics and adding new dynamic data displays and links

m. Alarm and Event management

n. Adding and removing network devices

-- End of Section --
PART 1   GENERAL

1.1   SYSTEM DESCRIPTION

Modify the exiting heating hot water system having the minimum service (design) temperature-pressure rating indicated. This specification covers new and replacement materials as indicated. The heating hot water system is filled with water. Provision of the piping systems, including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the required and advisory provisions of ASME B31.9 except as modified or supplemented by this specification section or design drawings.

1.2   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606 (2015) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)
ASME B16.15 (2013) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18 (2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21 (2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.39 (2014) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250,
and 300

ASME B31.1 (2014; INT 1-47) Power Piping
ASME B31.9 (2017) Building Services Piping
ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM B62 (2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM D2000 (2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110 (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends


MSS SP-80 (2013) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2016; SUPP 20162018) Motors and Generators

PLUMBING-HEATING-COOLING CONTRACTORS ASSOCIATION (PHCC)


1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
  Panel Radiators
  Strainers
  Tubing
  Fittings
  Materials And Accessories
  Valves For Low Temperature Water Heating

SD-06 Test Reports
  Testing and Cleaning

1.4 QUALITY ASSURANCE

Procedures and welders shall be qualified in accordance with the code under which the welding is specified to be accomplished.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants.
PART 2   PRODUCTS

2.1  MATERIALS AND EQUIPMENT

2.1.1  Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer's representative, reasonably convenient to the site.

2.1.2  Nameplates

Place a plate on each major item of equipment having the manufacturer's name, address, type or style, model or serial number, and catalog number secured to the item of equipment.

2.1.3  Equipment Guards and Access

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.1.4  Asbestos Prohibition

Asbestos and asbestos-containing products will not be accepted.

2.1.5  Electrical Work

Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electric equipment (including motor efficiencies), and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Electrical characteristics shall be as specified or indicated. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring, conduit, and connection to power required for controls and devices but not shown shall be provided.

Provide variable frequency drives for motors as specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

2.2  PIPING, TUBING, AND FITTINGS

2.2.1  Gauge Piping

Piping shall be copper tubing.

2.2.2  Copper Tubing

Tubing shall conform to ASTM B88, ASTM B88M, Type K or L. Tubing for
2.2.3 Joints and Fittings for Copper Tubing

Wrought copper and bronze fittings shall conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy fittings shall conform to ASME B16.18 and ASTM B828. Flared fittings shall conform to ASME B16.26 and ASTM B62. Adaptors may be used for connecting tubing to flanges and threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Cast bronze threaded fittings shall conform to ASME B16.15. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and and bolts for use in grooved joints shall be steel and shall conform to ASTM A183.

2.2.4 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.2.5 Nipples

Nipples shall conform to ASTM A733 or ASTM B687, standard weight.

2.2.6 Unions

Unions shall conform to ASME B16.39, type to match adjacent piping.

2.2.7 Adapters

Adapters for copper tubing shall be brass or bronze for soldered fittings.

2.2.8 Dielectric Waterways

Dielectric waterways shall conform to the tensile strength and dimensional requirements specified in ASME B16.39. Waterways shall have metal connections on both ends to match adjacent piping. Metal parts of dielectric waterways shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.2.9 Grooved Mechanical Joints

Rigid grooved pipe joints may be provided in lieu of unions, welded, flanges or screwed piping connections at chilled water pumps and allied equipment, and on aboveground pipelines in serviceable locations, if the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact.
with equal amount of pad offset of housings upon installation to insure positive rigid clamping of the pipe. Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications, will not be permitted. Rigid grooved pipe couplings shall be used with grooved end pipes, fittings, valves and strainers. Rigid couplings shall be designed for not less than 125 psi service and appropriate for static head plus the pumping head, and shall provide a water-tight joint. Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Contracting Officer's representative shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and verify the groove dimensions in accordance with the coupling manufacturer's specifications.

2.2.10 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service as appropriate for the static head plus the system head, and 250 degrees F. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, temperature, and circulating medium. The flexible section may have threaded, welded, soldered, flanged, grooved, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.3 MATERIALS AND ACCESSORIES

2.3.1 Solder

Solder shall conform to ASTM B32. Solder and flux shall be lead free. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B813.

2.3.2 Solder, Silver

Silver solder shall conform to AWS A5.8/A5.8M.

2.3.3 Thermometers and Temperature Gauges

Where replacement gauges are indicated, non powered gauges in accordance with specification are preferred. Replacement with powered gauges matching existing is allowed where clearance or existing thermowells is incompatible with new non-powered gauge.
2.3.3.1 Thermometers

Mercury shall not be used in thermometers. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale, and thermometers shall have rigid stems with straight, angular, or inclined pattern.

2.3.3.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment.

2.3.3.3 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.3.4 Gauges

Gauges shall conform to ASME B40.100.

2.3.5 PT Plugs

Accessory installed on piping or components that allows pressure and temperature checks by inserting probes through a self sealing membrane into the fluid stream. Brass Body and core material suitable for the service, shall accept 1/8" probes, and include threaded cap with retainer strap. Body length to suit pipe insulation thickness to allow access without disturbing the finished pipe insulation.

2.3.6 Gaskets for Flanges

Composition gaskets shall conform to ASME B16.21. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service. Gaskets shall be suitable for pressure and temperatures of piping system.

2.3.7 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

2.4 VALVES FOR LOW TEMPERATURE WATER HEATING

2.4.1 Check Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 3 or 4, Class 125.
2.4.2 Angle Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 125.

2.4.3 Ball Valve

Full port design. Ball valves 1/2 inch and larger shall conform to MSS SP-110 and shall be bronze or brass pressure and temperature rated for the application with threaded, soldered, or flanged ends. Ball valves may be combined with balance valves as a combination unit. Provide with stem extention.

2.4.4 Air Vents

Manually-operated general service type air venting valves, brass or bronze valves that are furnished with threaded plugs or caps. Air venting valves on water coils shall have not less than 1/8 inch threaded end connections. Air venting valves on water mains shall have not less than 3/4 inch threaded end connections. Air venting valves on all other applications shall have not less than 1/2 inch threaded end connections.

2.4.5 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register degree of valve opening. Valves shall be calibrated so that flow in gpm can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 250 degrees F temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.4.6 Automatic Flow Control Valves

Also indicated as Automatic Balance Valves (ABV). The valves shall be designed to be sensitive to pressure differential across the valve to provide the required opening. The valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psi or 150 percent of the system operating pressure, whichever is greater. Valves shall be suitable for the maximum system operating temperature and pressure. Valve materials shall be same as specified for low temperature heating system valves.

Provide self-contained valve as indicated. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and differential meter, suitable for the operating pressure indicated. The automatic balance valve may be combined with integral ball valves.
2.4.7 Radiator Valves

Automatic thermostatic radiator valves (TRV) shall be self-contained direct sensor or remote sensor as indicated for controlled nonelectric temperature control valves. Valve bodies shall be constructed of chrome plated brass and shall be angle or straight pattern as indicated, with threaded or brazed end connections. Unplated brass valves are acceptable where concealed. Valve disc shall be of ethylene propylene or composition material. Thermostatic operators shall be a modulating type consisting of a sensing unit counter balanced by a spring setting.

2.5 SYSTEM EQUIPMENT AND ACCESSORIES

2.5.1 Drains

Install a drain connection with 3/4 inch hose bib at the lowest point in the low temperature water return main near the heat exchanger. In addition, install threaded drain connections with threaded cap or plug wherever required for thorough draining of the low temperature water system.

2.5.2 Strainers

Basket or Y-type strainer-body connections shall be the same size as the pipe lines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with nipple and gate valve for blowdown. The basket for steam systems shall be of not less than 0.025 inch thick stainless steel, or monel with small perforations of sufficient number to provide a net free area through the basket of at least 2.5 times that of the entering pipe. Provide minimum Cv ratings as indicated. The flow shall be into the basket and out through the perforations.

2.6 INSULATION

Shop and field applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.7 RADIATORS AND CONVECTORS

See plans for existing Fin Tube radiators and convectors modified or replaced.

2.7.1 Panel Radiators

Unit Work Item #3: Panel radiators shall suitable for hot water hydronic heating systems operating up to 200 degrees F and 145 psi. Radiator shall be factory pressure tested at 180 psi minimum. Construction shall be of steel fluted panel welded to a water channel. Color shall be white baked powder coating finish. Panel shall be equipped with thermostatic radiator control valve, air vent, flow setter and drain plug. Connections shall be at the bottom of the panel, right or left hand configuration shall be field reversible.

2.7.2 Radiators and Convectors Control

Unit Work Item #2: Replace existing thermostatic radiator control valve
with new configured as indicated to automatically regulate water flow to the fin tube radiators by the self-contained, automatic thermostatic radiator control valves.

Where indicated, modify existing fin tube radiator DDC control valve location under Base Work. DDC valves shall be provided as specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEM FOR HVAC. Reuse of existing valve heads is permitted. Unit Work Item #1 shall be similar.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer's representative of any discrepancy before performing the work.

3.2 INSTALLATION

Install all work as indicated and in accordance with the manufacturer's diagrams and recommendations.

3.3 COLOR CODE MARKING

Requirements for color coding for piping identification are specified in ASME A13.1.

3.4 PIPING

Unless otherwise specified, pipe and fittings installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cuttings or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall be so installed as to permit free expansion and contraction without causing damage to building structure, pipe, joints, or hangers. Changes in direction shall be made with factory made fittings, except that bending of pipe up to 4 inches will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center line radius of bends shall not be less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be installed through the roof as indicated and shall be flashed as specified. Horizontal mains shall pitch up or down in the direction of flow as indicated. The grade shall be not less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unions and other components for copper pipe or tubing shall be brass or bronze. Connections between ferrous and copper piping shall be electrically isolated using dielectric unions.

3.4.1 Joints

Except as otherwise specified, joints between sections of copper tubing or copper pipe shall be flared or sweated. Unless otherwise specified, connections to equipment shall be made with unions for pipe 2-1/2 inches or
smaller in diameter, and with flanges for pipe 3 inches or larger in
diameter.

3.4.2 Low Temperature Systems

Piping may have threaded, flanged or flared, sweated, or grooved mechanical
joints as applicable and as specified. Reducing fittings shall be used for
changes in pipe sizes. In horizontal lines, reducing fittings shall be the
eccentric type to maintain the top of the adjoining pipes at the same level.

3.4.3 Threaded Joints

Threaded joints shall be made with tapered threads properly cut, and shall
be made tight with PTFE tape complying with ASTM D3308, or equivalent
thread joint compound applied to the male threads only, and in no case to
the fittings.

3.4.4 Flanged Joints or Unions

Flanged joints or unions shall be provided in each line immediately
preceding the connection to each piece of equipment or material requiring
maintenance such as coils, pumps, control valves, and similar items.
Flanged joints shall be faced true, provided with gaskets, and made square
and tight. Full-faced gaskets shall be used with flanges.

3.4.5 Flared and Sweated Pipe and Tubing

Pipe and tubing shall be cut square and burrs shall be removed. Both
inside of fittings and outside of tubing shall be cleaned with an abrasive
before sweating. Care shall be taken to prevent annealing of fittings and
hard drawn tubing when making connection. Installation shall be made in
accordance with the manufacturer's recommendations. Changes in direction
of piping shall be made with flared or soldered fittings only. Solder and
flux shall be lead free. Joints for soldered fittings shall be made with
silver solder or 95:5 tin-antimony solder. Cored solder shall not be
used. Joints for flared fittings shall be of the compression pattern.
Swing joints or offsets shall be provided on all branch connections, mains,
and risers to provide for expansion and contraction forces without undue
stress to the fittings or to short lengths of pipe or tubing.

3.4.6 Mechanical Tee Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall
be produced with an appropriate tool by drilling a pilot hole and drawing
out the tube surface to form a collar having a minimum height of three
times the thickness of the tube wall. To prevent the branch tube from
being inserted beyond the depth of the extracted joint, dimpled depth stops
shall be provided. The branch tube shall be notched for proper penetration
into fitting to assure a free flow joint. Joints shall be brazed in
accordance with NAPHCC NSPC. Soldered joints will not be permitted.

3.4.7 Grooved Joints for Copper Tube

Grooves shall be prepared according to the coupling manufacturer's
instructions. Grooved fittings, couplings, and grooving tools shall be
products of the same manufacturer. Pipe and groove dimensions shall comply
with the tolerances specified by the coupling manufacturer. The diameter
of grooves made in the field shall be measured using a "go/no-go" gauge,
vernier or dial caliper, narrow-land micrometer, or other method
specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.5 CONNECTIONS TO EQUIPMENT

Supply and return connections shall be provided by the Contractor unless otherwise indicated. Valves and traps shall be installed in accordance with the manufacturer's recommendations. Unless otherwise indicated, the size of the supply and return pipes to each piece of equipment shall be not smaller than the connections on the equipment. No bushed connections shall be permitted. Change in sizes shall be made with reducers or increasers only.

3.5.1 Low Temperature Water and Steam and Return Connections

Connections, unless otherwise indicated, shall be made with malleable iron unions for piping 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter.

3.6 BRANCH CONNECTIONS

Branches shall pitch up or down as indicated, unless otherwise specified. Connection shall be made to insure unrestricted circulation, eliminate air pockets, and permit drainage of the system.

3.7 SUPPORTS

3.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. All piping subjected to vertical movement when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers. Where threaded rods are used for support, they shall not be formed or bent.

3.7.1.1 Structural Attachments

Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be standard structural steel shapes or preformed strut channel suitable for the applicaton. Pipe hanger loads suspended from steel joist panel points shall not exceed 50 pounds. Loads exceeding 50 pounds shall be suspended from panel points.

3.7.1.2 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run.
3.7.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

3.8 PIPE SLEEVES

3.8.1 Fire Seal

Where pipes pass through secure walls or floors above grade, a fire seal shall be provided as indicated.

3.8.2 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or covered, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe sleeves or to extensions of sleeves without any part of sleeves being visible. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrew.

3.9 ANCHORS

Existing anchors shall be maintained when encountered or indicated to localize expansion or prevent undue strain on piping.

3.10 PIPE EXPANSION

The expansion of supply and return pipes shall be provided for by changes in the direction of the run of pipe, by expansion loops, or by expansion joints.

3.10.1 Expansion Loops

Expansion loops shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1.

3.11 VALVES AND EQUIPMENT ACCESSORIES

3.11.1 Valves and Equipment

Valves shall be installed at the locations shown or specified, and where required for the proper functioning of the system as directed. Ball valves shall be used unless otherwise indicated, specified, or directed. Valves shall be installed with their stems horizontal to or above the main body of the valve. Valves used with ferrous piping shall have threaded or flanged ends and sweat-type connections for copper tubing.

3.11.2 Air Vents

Vents shall be installed on all high points and piping offsets where air can collect or pocket.

3.12 INSULATION

Thickness of insulation materials for piping and equipment and application shall be in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.
3.13 TESTING AND CLEANING

Submit performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

3.13.1 Pressure Testing

Notify the Contracting Officer's representative 2 days before the tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer's representative. Furnish all instruments and personnel required for the tests. Electricity, and water will be furnished by the Government. All test results shall be accepted before thermal insulation is installed. The entire low temperature heating system, including heat exchanger, radiators and fittings, shall be hydrostatically tested and proved tight under a pressure of 45 psig for a period of four hours.

3.13.2 Cleaning

After the hydrostatic tests have been made and prior to the operating tests, the heat exchanger and piping shall be operated for 8 hours at full flow followed by cleaning all system stainers. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. The Contractor will be responsible for maintaining the system in a clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer.

3.14 TESTING, ADJUSTING AND BALANCING

Except as specified herein, testing, adjusting, and balancing shall be in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

-- End of Section --
PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606 (2015) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding


AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel


ASME INTERNATIONAL (ASME)


ASME B16.18 (2018) Cast Copper Alloy Solder Joint Pressure Fittings


ASME B31.9 (2017) Building Services Piping

ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)


ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


ASTM B62 (2017) Standard Specification for Composition Bronze or Ounce Metal Castings


ASTM D520 (2000; R 2011) Zinc Dust Pigment

ASTM D1384 (2005; R 2012) Corrosion Test for Engine Coolants in Glassware

ASTM D2000 (2012; R 2017) Standard Classification System for Rubber Products in Automotive Applications


ASTM F1199 (1988; R 2015) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

INTERNATIONAL CODE COUNCIL (ICC)


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)


MSS SP-67 (2017; Errata 1 2017) Butterfly Valves

MSS SP-71  (2011; Errata 2013) Gray Iron Swing Check Valves, Flanged and Threaded Ends

MSS SP-78  (2011) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80  (2013) Bronze Gate, Globe, Angle and Check Valves

MSS SP-110 (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1  (2016; SUPP 20162018) Motors and Generators


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


1.2 SYSTEM DESCRIPTION

Modify the exiting chilled water systems having the minimum service (design) temperature-pressure rating indicated. This specification covers new and replacement materials as indicated. The chilled water system currently is filled with 40% ethylene glycol which should be reused to the greatest extent possible. Future design concentration is 30% ethylene glycol maintained by a premixed glycol feeder installed by this project. Provision of the piping systems, including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the required and advisory provisions of ASME B31.9 except as modified or supplemented by this specification section or design drawings.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

   SD-03 Product Data
   Calibrated Balancing Valves
   Automatic Flow Control Valves
   Glycol
   Glycol Feeder
Copper Tubing And Fittings
SD-06 Test Reports
Pressure Tests Reports
SD-10 Operation and Maintenance Data

Requirements for operation and maintenance manuals are specified Section 01 78 00 CLOSEOUT SUBMITTALS except as supplemented and modified by this specification section.

1.4 MODIFICATIONS TO REFERENCES

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For USCG owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.5 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any
discrepancy before performing any work.

1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.7.3 Accessibility

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

The two year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures.

Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. System components shall be environmentally suitable for the indicated locations.

The equipment items shall be supported by service organizations. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.2 COPPER TUBING

Provide copper tubing and fittings with a ANSI/ASME Class 125 service rating, which for 150 degrees F., the pressure rating is 175 psig.

2.2.1 Tube

Use copper tube conforming to ASTM B88, Type L or M for aboveground tubing, and Type K for buried tubing.

2.2.2 Fittings and End Connections (Solder and Flared Joints)

Wrought copper and bronze solder joint pressure fittings, including unions and flanges, shall conform to ASME B16.22 and ASTM B75/B75M. Provide
adapters as required. Cast copper alloy solder-joint pressure fittings, including unions and flanges, shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. ASTM B42 copper pipe nipples with threaded end connections shall conform to ASTM B42.

Copper tubing of sizes larger than 4 inches shall have brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

Extracted brazed tee joints may be used if produced with an acceptable tool and installed in accordance with tool manufacturer's written procedures.

2.2.3 Grooved Mechanical Connections For Copper

Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein.

Each grooved mechanical joint shall be a system, including coupling housing, gasket, fasteners, all furnished by the same manufacturer. Joint installation shall be in compliance with joint manufacturer's written instructions.

Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Provide gaskets for use in grooved joints shall constructed of molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 230 degrees F. Provide grooved joints in conformance with AWWA C606.

2.2.4 Solder

Provide solder in conformance with ASTM B32, grade Sb5, tin-antimony alloy. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B813.

2.2.5 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.3 Condensate Drain Piping

Provide PVC schedule 40 piping with PVC drain waste and vent fittings in accordance with ICC IPC. Insulate where indicated.

2.4 VALVES

Provide valves with a ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig.

2.4.1 Check Valve

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80. Check
valves 3 inches and larger shall conform to MSS SP-71, Class 125.

2.4.2 Butterfly Valve

Butterfly valves shall conform to MSS SP-67, Type 1 and shall be either the wafer or lug type. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators.

2.4.3 Plug Valve

Plug valves 2 inches and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 2 inches and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug.

2.4.4 Ball Valve

Full port design. Ball valves 1/2 inch and larger shall conform to MSS SP-110 and shall be brass or bronze with threaded, soldered, or flanged ends.

2.4.5 Calibrated Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts. Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall function as a service valve when in fully closed position. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.

Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential. Provide metal tag on each valve showing the gallons per minute flow for each differential pressure reading. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.4.6 Automatic Flow Control Valves

Also indicated as Automatic Balance Valves (ABV). Valve shall automatically maintain the constant flow indicated on the design drawings. Valve shall modulate by sensing the pressure differential across the valve body. Valve shall be selected for ethylene glycol as indicated for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Provide valve that controls the flow within 5 percent of the tag rating. Valve materials shall be the same as specified for the ball or plug valves.

Provide self-contained valve as indicated. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of
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pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and differential meter, suitable for the operating pressure indicated. The automatic balance valve may be combined with integral ball valves.

2.4.7 Drain Valves

Valve shall be manually-operated, 3/4 inch pipe size and above with a threaded end connection. Provide valve with a water hose nipple adapter and tethered threaded cap..

2.4.8 Air Venting Valves

Manually-operated general service type air venting valves, brass or bronze valves that are furnished with threaded plugs or caps. Air venting valves on water coils shall have not less than 1/8 inch threaded end connections. Air venting valves on water mains shall have not less than 3/4 inch threaded end connections. Air venting valves on all other applications shall have not less than 1/2 inch threaded end connections.

2.5 PIPING ACCESSORIES

2.5.1 Strainer

Strainer, ASTM F1199, except as modified and supplemented in this specification. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer bodies shall be fabricated of brass or bronze with bottoms drilled, and tapped. Provide blowoff outlet with pipe nipple, ball valve, and discharge pipe nipple. The bodies shall have arrows clearly cast on the sides indicating the direction of flow.

Provide strainer with removable cover and sediment screen. The screen shall be made of minimum 22 gauge corrosion-resistant steel, with small perforations numbering not less than 50 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe with minimum Cv as indicated. The flow shall be into the screen and out through the perforations. Strainers may be combined with ball isolation valves.

2.5.2 Flexible Pipe Connectors

Provide flexible bronze or stainless steel piping connectors with single braid. Equip flanged assemblies with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Provide covers to protect the bellows where indicated.

2.5.3 Pressure and Vacuum Gauges

Gauges, ASME B40.100 with throttling type needle valve or a pulsation dampener and shut-off valve. Provide gauges with 4.5 inch dial, brass or aluminum case, bronze tube, and siphon. Gauge shall have a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.
2.5.4 Temperature Gauges

Where replacement gauges are indicated, non powered gauges in accordance with specification are preferred. Replacement with powered gauges matching existing is allowed where clearance or existing thermowells is incompatible with new non-powered gauge.

Temperature gauges, shall be the industrial duty type and be provided for the required temperature range. Provide gauges with fixed thread connection, dial face gasketed within the case; and an accuracy within 2 percent of scale range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor or in locations indicated. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor or in locations indicated.

2.5.4.1 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment.

2.5.4.2 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.5.5 PT Plugs

Accessory installed on piping or components that allows pressure and temperature checks by inserting probes through a self sealing membrane into the fluid stream. Brass Body and core material suitable for the service, shall accept 1/8" probes, and include threaded cap with retainer strap. Body length to suit pipe insulation thickness to allow access without disturbing the finished pipe insulation.

2.5.6 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports: to MSS SP-58 and MSS SP-69.

2.5.7 Escutcheons

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Secure plates in place by internal spring tension or set screws. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.
2.6 WATER TREATMENT SYSTEMS

Reuse of existing glycol mixture is intended. Capture system fluid in clean containers when performing work. Strain as required when refilling the system. New glycol shall be compatible with existing as determined by the COR.

2.6.1 Glycol Solution

A 30 percent concentration by volume is the new design concentration of industrial grade ethylene glycol in the chilled water. Pretest existing concentration prior to work. New glycol shall be tested in accordance with ASTM D1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

2.6.2 Glycol Feed System

The Glycol Feeder shall be a packaged unit designed for the application to automatically maintain the desired glycol content of the closed water recirculation system. Each unit shall consist of the following components:

2.6.2.1 Supply Tank and Stand

Include a cross lined polyethylene tank, size as indicated and steel support stand. The tank shall have a cover and bottom outlet fitting for pump suction. Equip the tank stand with a pump mounting platform and support for the control panel and level switch.

2.6.2.2 Glycol Pump

Rotary gear type of bronze construction with a capacity of 1.8 gpm at 40 psi. The pump capacity, motor horsepower and power requirements shall be as indicated and have an internal pressure relief. Provide the pump with a discharge check valve and shutoff valve.

2.6.2.3 Pressure Switch

The pressure switch shall be adjustable over the range and differential indicated and have contacts rated for indicated voltage.

2.6.2.4 Level Switch

Equipped with N/O and N/C contacts to activate upon sensing a low level condition.

2.6.2.5 Control Panel

The control panel shall be installed in a NEMA 1 enclosure with terminal strip and shall include a red low level alarm light, full voltage motor starter for the glycol pump, and a Hand-Off-Auto selector switch.

2.7 ELECTRICAL WORK

Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including
motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Provide variable frequency drives for motors as specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.

2.8 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

2.8.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided. The factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be in accordance with ASTM B117, and for that test, the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen.

If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

2.8.2 Shop Painting Systems for Metal Surfaces

Clean, retreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and
solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where hot-dip galvanized steel has been cut, resulting surfaces with no galvanizing shall be coated with a zinc-rich coating conforming to ASTM D520, Type I.

Where more than one coat of paint is provided, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

2.9 FACTORY APPLIED INSULATION

Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 25 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E84.

Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.10 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, type or style, model or serial number on a plate secured to the item of equipment. The nameplate of the distributing agent will not be acceptable. Plates shall be durable and legible throughout equipment life.
2.11 RELATED COMPONENTS/SERVICES

2.11.1 Drain and Make-Up Water Piping

Copper in accordance with ICC IPC.

2.11.2 Field Applied Insulation

Requirements for field applied insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.11.3 Field Painting

Requirements for painting of surfaces not otherwise specified, and finish painting of items only primed at the factory, are as indicated.

2.11.3.1 Color Coding

Requirements for color coding for piping identification are specified in ASME A13.1.

PART 3 EXECUTION

3.1 INSTALLATION

Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation is not permitted without written approval. Cut pipe or tubing square, remove burrs by reaming, and fashion to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

Notify the Contracting Officer's representative in writing at least 7 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.1 Welding

Provide welding work specified this section for piping systems in conformance with ASME B31.9, as modified and supplemented by this specification section and the accompanying drawings. The welding work includes: qualification of welding procedures, welders, welding operators, brazers, brazing operators, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

3.1.1.1 Welding Safety

Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

3.1.2 Directional Changes

Make changes in direction with fittings, except that bending of pipe 4 inches and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar
construction to form elbows or tees is not permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.

3.1.3 Functional Requirements

Pitch horizontal supply mains down in the direction of flow as indicated. The grade shall not be less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Cap or plug open ends of pipelines and equipment during installation to keep dirt or other foreign materials out of the system.

Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges.

Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation fittings shall be provided between dissimilar metals.

3.1.4 Fittings and End Connections

3.1.4.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.4.2 Brazed Connections

Brazing, AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.4.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.9. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1/D1.1M or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.
3.1.4.4 Grooved Mechanical Connections

Prepare grooves in accordance with the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.1.4.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.4.6 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for the intended application.

3.1.5 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.6 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.
3.1.9 Temperature Gauges

Temperature gauges shall be located on coolant supply and return piping at each heat exchanger, on condenser water piping entering and leaving a condenser, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch.

3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as supplemented and modified in this specification section. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.10.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.1.10.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.1.10.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.1.10.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.10.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.1.10.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.
3.1.10.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

3.1.10.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.10.9 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.10.10 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer's representative. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be standard structural steel shapes or preformed strut channel suitable for the application.

3.1.11 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Except as indicated otherwise piping sleeves shall comply with requirements specified. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A653/A653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A53/A53M, Standard weight. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

3.1.11.1 Fire Seal

Where pipes pass through secure walls or floors above grade, a fire seal shall be provided as indicated.

3.1.11.2 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.
3.2 ELECTRICAL INSTALLATION

Install electrical equipment in accordance with NFPA 70 and manufacturers instructions.

3.3 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.4 FIELD TESTS

Field tests shall be conducted in the presence of the QC Manager or his designated representative to verify systems compliance with specifications. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor.

3.4.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the tests shall be properly isolated.

3.4.2 Pressure Tests

Each piping system, shall be hydrostatically tested at a pressure not less than 50 psig for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Test pressure shall be monitored by a currently calibrated test pressure gauge. Leaks shall be repaired and piping retested until test requirements are met. No leakage or reduction in gage pressure shall be allowed.

Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before concealing.

Submit for record pressure tests reports covering the above specified piping pressure tests; describe the systems tested, test results, defects found and repaired, and signature of the pressure tests' director. Obtain approval from the QC Manager before concealing piping or applying insulation to tested and accepted piping.

3.4.3 Related Field Inspections and Testing

3.4.3.1 HVAC TAB

Requirements for testing, adjusting, and balancing (TAB) of HVAC water piping, and associated equipment is specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Coordinate with the TAB team, and provide support personnel and equipment as specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC to assist TAB team to meet the TAB work requirements.
3.5 INSTRUCTION TO GOVERNMENT PERSONNEL

Furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the chilled water system. Instructors shall be thoroughly familiar with all parts of the installation and shall be instructed in operating theory as well as practical operation and maintenance work.

Conduct a training course for the operating staff and maintenance staff selected by the Contracting Officer's representative. Give the instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Allow 2 hours minimum of instruction.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

-- End of Section --
PART 1  GENERAL

1.1  RELATED REQUIREMENTS

Salient features required by the new and replacement equipment specified under this section require direct control by the building automation system or BAS specified under Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEM FOR HVAC. Condensate pump salient features are highly reliable without a filter screen and very low maintenance. The indicated control setup is based upon Mitsubishi Electric equipment and MaxiBlue condensate pump by Blue Diamond Pumps. Alternate manufacturers are allowed but alternate manufacturers must meet the salient features of this specification and as indicated.

1.2  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 700  (2016) Specifications for Fluorocarbon Refrigerants


AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)


AMERICAN WELDING SOCIETY (AWS)

ASTM INTERNATIONAL (ASTM)
ASTM C1071 (20162019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520 (2000; R 2011) Zinc Dust Pigment

INTERNATIONAL CODE COUNCIL (ICC)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA MG 1 (2016; SUPP 20162018) Motors and Generators

UNDERWRITERS LABORATORIES (UL)

1.3 SUBMITTALS
Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Drawings
SD-03 Product Data
   Training
   Manufacturer's Standard Catalog Data
   Condensate Pumps
SD-06 Test Reports
Refrigerant Tests, Charging, and Start-Up
SD-10 Operation and Maintenance Data
Operating and Maintenance Manuals

1.4 QUALITY ASSURANCE

Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

a. Equipment layouts which identify assembly and installation details.

b. Installation instructions and details

c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

d. Equipment schedules.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Properly protect and care for all material both before and during installation. Replace any materials found to be damaged, at no additional cost to the Government. During installation, cap piping and similar openings capped to keep out dirt and other foreign matter.

1.6 WARRANTY

Provide equipment with the Manufacturer's Standard Warranty. Mini-splits, 7 year compressor, 5 year on parts; condensate pump 3 years manufacturer's warranty.

PART 2 PRODUCTS

2.1 ENERGY EFFICIENCY REQUIREMENTS


2.2 MATERIALS

Provide Manufacturer's standard catalog data, at least 2 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data includes manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit data for each specified component. Minimum
efficiency requirements must be in accordance with ASHRAE 90.1 - IP.

2.2.1 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for 2 years prior to request for proposal. The 2 year use includes applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products must be supported by a service organization. Ensure system components are environmentally suitable for the indicated geographic locations.

2.2.2 Product Sustainability Criteria

2.2.2.1 Energy Efficient Equipment

Provide equipment meeting the efficiency requirements as indicated.

2.2.2.2 Electrical Equipment / Motors

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified must be provided complete with motors, motor starters, and controls. Electrical characteristics must be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, must be the premium efficiency type in accordance with NEMA MG 1. Field wiring must be in accordance with manufacturer's instructions. Each motor must conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors must be continuous duty with the enclosure specified. Motor starters must be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors must be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors must be sized for the applicable loads. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, must be provided.

2.2.2.3 Ozone Depleting Substances

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant may be an approved alternative refrigerant in accordance with EPA's Significant New Alternative Policy (SNAP) listing.
2.2.3 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life.

2.2.4 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

2.3 EQUIPMENT

2.3.1 Mini-Split-System Air Conditioners and Heat Pumps

2.3.1.1 Small-Capacity Split-System Air-Conditioners (Not Exceeding 65,000 Btu/hr)

Provide an air-cooled, split system which employs a remote condensing unit, a separate wall mounted indoor unit, and interconnecting refrigerant piping. Provide the heat pump or air conditioner as indicated type unit conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with ANSI/AHRI 210/240. Provide indoor unit with necessary fans, air filters, and galvanized steel cabinet construction. The remote unit must be as specified in paragraph Remote Condeser or Condensing Unit. Provide double-width, double inlet, forward curved backward inclined, or airfoil blade, centrifugal scroll type evaporator or supply fans. Provide the manufacturer's standard condenser or outdoor fans for the unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors must have manufacturer's standard enclosures. Design unit to operate at outdoor ambient temperatures low ambient as indicated and up to 115 degrees F.

2.3.1.1.1 Energy Efficiency

Provide unit with an Energy Star label when available. Heat Pumps and Air Conditioners must have a minimum seasonal energy efficiency ratio (SEER) and minimum Heating Seasonal Performance Factor (HSPF) as indicated.

2.3.1.1.2 Air-to-Refrigerant Coil

Provide condensing coils with copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing must be galvanized steel or aluminum. Avoid contact of dissimilar metals. Test coils in accordance with ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil testing and prior to evaluation and charging.

2.3.1.1.3 Compressor

Provide direct drive variable speed type compressor. Provide compressor with internal over temperature and pressure protector; sump heater; oil pump;
high pressure and low pressure controls; and liquid line dryer.

2.3.1.1.4 Refrigeration Circuit

Refrigerant-containing components must comply with ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide each unit with a factory operating charge of refrigerant and oil or a holding charge. Field charge unit shipped with a holding charge. Provide refrigerant charging valves. Provide filter-drier in liquid line to prevent freeze-up in event of loss of water flow during heating cycle.

2.3.1.1.5 Unit Controls

Provide accessory that allows standard thermostatic control as indicated. The accessory shall be connected to the BAS for direct control of the unit to supplement the building's HVAC system. Provide unit internally prewired with a control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Internally protect unit by fuses or a circuit breaker in accordance with UL 1995.

2.3.1.1.6 Condensing Coil

Provide coils with copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Provide galvanized steel or aluminum casing. Avoid contact of dissimilar metals. Test coils in accordance with ANSI/ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal each coil after testing and prior to evaluation and charging. Provide separate expansion devices for each compressor circuit.

2.3.1.1.7 Remote Condenser or Condensing Unit

Fit each remote condenser coil fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature must not exceed 120 degrees F at 104 degrees F ambient. Provide unit with low ambient condenser controls to ensure proper operation in an ambient temperature as indicated. Provide fan and cabinet construction as specified in paragraph Cabinet Construction. enclosures.

2.3.1.1.7.1 Sound Rating

Provide units of capacities less than 135,000 Btu/h with a maximum AHRI sound rating of 50 dB when rated in accordance with ANSI/AHRI 270.

2.3.1.1.7.2 Air-Cooled Condenser

Provide unit in accordance with ANSI/AHRI 460 and conform to the requirements of UL 1995. Provide factory fabricated, tested, packaged, and self-contained unit; complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary accessories.

2.3.1.1.8 Air Filters

Provide filters of the cleanable type that are capable of filtering the entire air supply. Mount filter(s) integral within the unit and make accessible by hinged access panel(s).
2.3.1.1.9 Fans

Provide direct driven, statically and dynamically balanced, centrifugal or propeller type fans. Design the outdoor fan so that condensate will evaporate without drip, splash, or spray on building exterior. Provide indoor fan with a minimum two-speed motor with built-in overload protection. Fan motors must be the inherently protected, permanent split-capacitor type.

2.4 COMPONENTS

2.4.1 Refrigerant and Oil

Refrigerant must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Provide a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil must be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge must be in accordance with manufacturer's recommendation.

2.4.2 Condensate Pumps

Where indicated provide condensate pumps for indoor fan coils. Condensate pumps shall be designed for high reliability and low maintenance. The pump shall have the capability to run dry without damage, pass solids and operate without a screen. Pump controls shall be compatible with indoor fan coil unit and installed outside the fan coil housing for easy access as indicated. Pumps shall have a high level switch that disables the mini-split. Pumps shall be UL listed.

2.4.3 Coil Frost Protection

Provide each circuit with a manufacturer's standard coil frost protection system. The coil frost protection system must use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Use timers to prevent the compressor from rapid cycling.

2.4.4 Cabinet Construction

Casings for the specified unitary equipment must be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces must be 18 gauge galvanized steel or 0.071 inch thick aluminum on units with a capacity above 20 tons and 20 gauge galvanized steel or 0.064 inch thick aluminum on units with a capacity less than 20 tons. Casing must be fitted with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness must be 20 gauge. Provisions to permit replacement of major unit components must be incorporated. Penetrations of cabinet surfaces, including the floor, must be sealed. Unit must be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan must be fabricated from Type 300 stainless steel, galvanized steel with protective coating as required, or an approved plastic material. Pan
insulation must be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces must prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation must conform to ASTM C1071. Paint and finishes must comply with the requirements specified in paragraph FACTORY COATING.

2.4.4.1 Indoor Cabinet

Indoor cabinets must be suitable for the specified indoor service and enclose all unit components.

2.4.4.2 Outdoor Cabinet

Outdoor cabinets must be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

2.4.5 Refrigerant Piping

Provide refrigerant piping in accordance with manufacturer's instructions.

2.4.6 Condensate Drain Piping

Provide clear vinyl tubing and fittings in accordance with condensate pump manufacturer's instructions. Provide PVC condensate drain piping and fittings in accordance with ICC IPC. Insulate where indicated.

2.5 FINISHES

2.5.1 Equipment and Components Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

2.5.2 Factory Applied Insulation

Refrigeration equipment must be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor in accordance with manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread
and smoke developed indexes must be determined by ASTM E84. Insulation must be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket must be tested as a composite material. Jackets, facings, and adhesives must have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

All manufactured units must be inspected and tested, and documentation provided to demonstrate that each unit is in compliance with ANSI/AHRI and UL requirements and that the minimum efficiency requirements of ASHRAE 90.1 - IP have been met.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Perform work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.2.1 Equipment

Provide refrigeration equipment conforming to ASHRAE 15 & 34. Provide necessary supports for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, condensers, and similar items. Isolate compressors from the building structure. If mechanical vibration isolators are not provided, provide vibration absorbing foundations. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.2 Field Applied Insulation

Apply field applied insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.3 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are as indicated.

3.3 CLEANING AND ADJUSTING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters must be provided for all fans that are operated during construction, and new filters must be installed after all construction dirt has been removed from the building. System must be maintained in this clean condition until final acceptance. Control valves and other miscellaneous equipment requiring adjustment must be adjusted to
setting indicated or directed. Fans must be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.4 TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer's representative. The training period must consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

a. Submit a schedule, at least 1 week prior to the date of the proposed training course, which identifies the date, time, and location for the training.

d. Submit operating and maintenance manuals in accordance with Section 01 78 00 CLOSEOUT SUBMITALS covering routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.5 REFRIGERANT TESTS, CHARGING, AND START-UP

Split-system refrigerant piping systems must be tested and charged and started up by a manufacturer's technical representative. Packaged refrigerant systems which are factory charged must be checked for refrigerant and oil capacity to verify proper refrigerant levels in accordance with manufacturer's recommendations. Following charging, packaged systems must be tested for leaks with a halide torch or an electronic leak detector.

a. The date the tests were performed.
b. A list of equipment used, with calibration certifications.
c. Initial test summaries.
d. Repairs/adjustments performed.
e. Final test results.

3.5.1 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances must the refrigerant be discharged into the atmosphere.

3.5.2 Contractor's Responsibility

Take steps, at all times during the installation and testing of the refrigeration system, to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time must more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year must be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.
3.6 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, conduct manufacturer's standard startup tests to demonstrate the general operating characteristics of all equipment by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system.

Make corrections and adjustments, as necessary, tests must be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, install and tighten service valve seal caps and blanks over gauge points. Replace any refrigerant lost during the system startup.

-- End of Section --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)
ASTM D709 (2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA 250 (2014) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2017) National Electrical Code

1.2  RELATED REQUIREMENTS

This section applies to certain sections of Division 02, EXISTING CONDITIONS and Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 ELECTRICAL of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
Section 26 51 00 INTERIOR LIGHTING

1.3  DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics
terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 480/277 or 120/208 volts secondary, three phase, four wire.

1.5 SUBMITTALS

SD-03 Product Data

Catalog cut sheets

1.6 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.6.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.6.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.7 QUALITY ASSURANCE

1.7.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.
1.7.2  Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 1 year prior to bid opening. The 1-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 1-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.7.2.1  Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.7.2.2  Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.8  WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.9  POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.
1.10 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.11 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.12 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.

1.13 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.14 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.
PART 2  PRODUCTS

2.1  FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

PART 3  EXECUTION

3.1  FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.2  FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3  WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --
PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM D709 (2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)


ANSI C80.3 (2005) American National Standard for Electrical Metallic Tubing (EMT)

NEMA 250 (2014) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA FU 1 (2012) Low Voltage Cartridge Fuses

NEMA ICS 6 (1993; R 2011) Enclosures

NEMA KS 1 (2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)

NEMA MG 1 (2016; SUPP 2016) Motors and Generators


NEMA WD 1 (1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017) National Electrical Code


TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-607 (2011b) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

UL 1 (2005; Reprint Jul 2012) Standard for Flexible Metal Conduit

UL 198M (2003; Reprint Feb 2013) Standard for Mine-Duty Fuses

UL 20 (2010; Reprint Feb 2012) General-Use Snap Switches

UL 360 (2013; Reprint Jan 2015) Liquid-Tight Flexible Steel Conduit


UL 486A-486B (2013; Reprint Feb 2014) Wire Connectors
1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.3 SUBMITTALS

Government approval is required for all submittals. Submit the following in accordance with Section 01 33 00.

SD-03 Product Data

Receptacles

Conduit and Wiring
Circuit breakers
Switches
Manual motor starters
Firestopping Material Sealing Systems
Fuses

1.4 QUALITY ASSURANCE

1.4.1 Fuses
Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements
In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products
Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 1 year prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 1-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications
Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date
Products manufactured more than 1 year prior to date of delivery to site are not acceptable.
1.5 WARRANTY

Provide equipment items supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND WIRING

Conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6 for exterior use.

2.2.2 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3 for interior use.

2.2.3 Flexible Metal Conduit

UL 1.

2.2.3.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.4 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings: cadmium- or zinc-coated in accordance with UL 514B.

2.2.4.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.4.2 Fittings for EMT

Steel compression type.

2.2.5 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.
2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

2.5.1 Conductors

Provide the following:

a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.

b. Conductors No. 8 AWG and larger diameter: stranded.

c. Conductors No. 10 AWG and smaller diameter: solid.

d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.

e. All conductors: copper.

2.5.1.1 Minimum Conductor Sizes

Provide minimum conductor size in accordance with the following:

a. Branch circuits: No. 12 AWG.

b. Class 1 remote-control and signal circuits: No. 14 AWG.

c. Class 2 low-energy, remote-control and signal circuits: No. 16 AWG.

d. Class 3 low-energy, remote-control, alarm and signal circuits: No. 22 AWG.

2.5.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.5.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

a. Grounding conductors: Green.


c. Exception, where neutrals of more than one system are installed in same raceway or box, other neutrals color coding: white with a different colored (not green) stripe for each.
2.5.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems as follows:

a. 208/120 volt, three-phase
   (1) Phase A - black
   (2) Phase B - red
   (3) Phase C - blue

b. 480/277 volt, three-phase
   (1) Phase A - brown
   (2) Phase B - orange
   (3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits: Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide the following:

a. UL listed, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

c. For nonmetallic boxes and fittings, other suitable plates may be provided.

Plates on finished walls: satin finish stainless steel or brushed-finish
aluminum, minimum 0.03 inch thick.

e. Screws: machine-type with countersunk heads in color to match finish of plate.

f. Sectional type device plates are not be permitted.

g. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, UL 20, single pole, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

a. Handles: ivory thermoplastic.

b. Wiring terminals: screw-type, side-wired or of the solderless pressure type having suitable conductor-release arrangement.

c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.

d. Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Utilize Class R fuseholders and fuses for fused switches, unless indicated otherwise. Provide horsepower rated for switches serving as the motor-disconnect means. Provide disconnect switches in NEMA 3R, enclosure per NEMA ICS 6.

2.9 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.9.1 Fuseholders

Provide in accordance with UL 4248-1.

2.9.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-1. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.9.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198M, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.
2.9.4 Cartridge Fuses, Current Limiting Type (Class T)
UL 198M, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.10 RECEPTACLES

Provide the following:

a. UL 498, hard use (also designated heavy-duty), UL 498 grounding-type.

b. Ratings and configurations: as indicated.

c. Bodies: ivory as per NEMA WD 1.

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per NEMA WD 6.

f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.10.1 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations". Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized cover plate.

2.10.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.11 CIRCUIT BREAKERS

2.11.1 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.11.1.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.
2.11.1.2 Circuit Breakers for HVAC Equipment

Provide circuit breakers for HVAC equipment having motors (group or individual) marked for use with HACR type and UL listed as HACR type.

2.12 MOTORS

Provide motors in accordance with the following:

a. NEMA MG 1.

b. Hermetic-type sealed motor compressors: Also comply with UL 984.

c. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified.

d. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters.

e. Rate motors for operation on 208-volt, 3-phase circuits with a terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits with a terminal voltage rating of 460 volts.

f. Use motors designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

g. Unless otherwise indicated, use continuous duty type motors if rated 1 HP and above.

h. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.12.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors: high efficiency types corresponding to the applications listed in NEMA MG 11. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.12.2 Premium Efficiency Polyphase Motors

Select polyphase motors based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10. In addition, continuous rated, polyphase squirrel-cage medium induction motors must meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.12.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to
wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.12.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment as specified herein. Power wiring and conduit: conform to the requirements specified herein. Control wiring: provided under, and conform to, the requirements of the section specifying the associated equipment.

2.13 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for surface mounting with overload protection and pilot lights.

2.13.1 Pilot Lights


2.14 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Comply with requirements of Division 23, "Mechanical" for mechanical isolation of machines and other equipment.

2.15 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.16 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

a. ASTM D709.

b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.

c. Each nameplate inscription: identify the function and, when applicable, the position.

d. Nameplates: melamine plastic, 0.125 inch thick, white with black center core.

e. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.

f. Minimum size of nameplates: one by 2.5 inches.
g. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.17 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.18 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations.

2.19 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.

c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: ANSI Light Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or
specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors.

3.1.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.2 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.2.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use outdoors.

3.1.2.2 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.2.3 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling
construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.2.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.2.5 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.2.6 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.3 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures: minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls: square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature;
provide readily removable fixtures for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.3.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets: a minimum of 4 11/16 inches square by 2 1/8 inches deep. Mount outlet boxes flush in finished walls.

3.1.3.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.3.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.4 Mounting Heights

Mount enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor.

3.1.5 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations.

3.1.6 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor
insulation.

3.1.7 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.8 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings.

3.1.9 Grounding and Bonding

Provide in accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.10 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications and are provided under the section specifying the associated equipment.

3.1.11 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as follows:

3.1.11.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.11.2 Existing Concealed Wiring to be Removed

Disconnect existing concealed wiring to be removed from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.11.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment includes equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.
3.1.11.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Maintain existing circuits of equipment energized. Restore circuits wiring and power which are to remain but were disturbed during demolition back to original condition.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer's Representative 5 working days notice prior to each test.

3.3.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

-- End of Section --
PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)


ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M (2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened


ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


ILLUMINATING ENGINEERING SOCIETY (IES)


1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires or luminaire accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in IEEE 100 and IES RP-16.

b. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in IES LM-80.

c. For LED luminaires, "Luminaire Efficacy" (LE) is the appropriate measure of energy efficiency, measured in lumens/watt. This is
gathered from LM-79 data for the luminaire, in which absolute photometry is used to measure the lumen output of the luminaire as one entity, not the source separately and then the source and housing together.

d. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Government approval is required for all submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Luminaires

Drivers, Ballasts and Generators

LED Luminaire Warranty

Energy Efficiency

1.5 QUALITY CONTROL

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70, unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the two-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.
1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than six months prior to date of delivery to site must not be used, unless specified otherwise.

1.5.2.3 Energy Efficiency

Submit data indicating lumens per watt efficacy and color rendering index of light source.

1.6 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.1 LED Luminaire Warranty

a. Provide a written 10 year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

(1) Include finish warranty to include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

(2) Material warranty must include:

(a) All drivers.

(b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

b. Warranty period must begin on date of beneficial occupancy. Provide the Contracting Officer's Representative with signed warranty certificates prior to final payment.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be luminaires, luminaire controls, or associated equipment are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 LUMINAIRES

UL 1598, NEMA C82.77, and UL 8750. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. Provide all luminaires of the same type by the same manufacturer. Luminaires must be specifically designed for use with the driver, ballast or generator and light source provided.

2.2.1 LED Luminaires

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life
in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum requirements in the following table:

<table>
<thead>
<tr>
<th>LUMINAIRE TYPE</th>
<th>MINIMUM LUMINAIRE EFFICACY (LE)</th>
<th>MINIMUM COLOR RENDERING INDEX (CRI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED TROFFER - 1 x 4</td>
<td>90 LPW</td>
<td>80</td>
</tr>
<tr>
<td>2 x 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 x 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED Downlight</td>
<td>50 LPW</td>
<td>90</td>
</tr>
<tr>
<td>LED Track or Accent</td>
<td>40 LPW</td>
<td>80</td>
</tr>
<tr>
<td>LED Low Bay/High Bay</td>
<td>80 LPW</td>
<td>70</td>
</tr>
<tr>
<td>LED Linear Ambient</td>
<td>80 LPW</td>
<td>80</td>
</tr>
</tbody>
</table>

LED luminaires must also meet the following minimum requirements:

a. Luminaires must have a minimum 10 year manufacturer's warranty.

b. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES TM-21, with data obtained per IES LM-80 requirements.

c. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

d. Luminaires must be tested to IES LM-79 and IES LM-80 standards, with the results provided as required in the Submittals paragraph of this specification.

e. Luminaires must be listed with the DesignLights Consortium 'Qualified Products List' when falling into category of "General Application" luminaires, i.e. Interior Directional, Display Case, Troffer, Linear Ambient, or Low/High Bay.

f. Provide Department of Energy 'Lighting Facts' label for each luminaire.

2.3 DRIVERS, BALLASTS and GENERATORS

2.3.1 LED Drivers

NEMA SSL 1, UL 8750. LED drivers must be electronic, UL Class 1, constant-current type and comply with the following requirements:

a. Output power (watts) and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.

b. Power Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.

c. Current draw Total Harmonic Distortion (THD) of less than 20 percent.

d. Class A sound rating.

e. Operable at input voltage of 120-277 volts at 60 hertz.
f. Minimum 10 year manufacturer's warranty.
g. RoHS compliant.
h. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.
i. UL listed for dry or damp locations typical of interior installations.

2.4 LUMINAIRE SUPPORT HARDWARE

2.4.1 Wire

ASTM A641/A641M; Galvanized, soft tempered steel, minimum 0.11 inches in diameter, or galvanized, braided steel, minimum 0.08 inches in diameter.

2.4.2 Wire for Humid Spaces

ASTM A580/A580M; Composition 302 or 304, annealed stainless steel, minimum 0.11 inches in diameter.

ASTM B164; UNS NO4400, annealed nickel-copper alloy, minimum 0.11 inches in diameter.

2.4.3 Threaded Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.4.4 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.5 EQUIPMENT IDENTIFICATION

2.5.1 Manufacturer's Namplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.6 FACTORY APPLIED FINISH

Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of NEMA 250 corrosion-resistance test.

2.7 RECESS- AND FLUSH-MOUNTED LUMINAIRES

Provide access to lamp and ballast from bottom of luminaire. Provide trim and lenses for the exposed surface of flush-mounted luminaires as indicated on project drawings and specifications.
PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations must conform to IEEE C2, NFPA 70, and to the requirements specified herein. Install luminaires and lighting controls to meet the requirements of ASHRAE 90.1-IP and ASHRAE 189.1. To encourage consistency and uniformity, install luminaires of the same manufacture and model number when residing in the same facility or building.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature, color rendering index, and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Installation must meet requirements of NFPA 70. Mounting heights specified or indicated must be to the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed luminaires must be independently supported from the building structure by a minimum of four wires, straps or rods per luminaire and located near each corner of the luminaire. Ceiling grid clips are not allowed as an alternative to independently supported luminaires. Round luminaires or luminaires smaller in size than the ceiling grid must be independently supported from the building structure by a minimum of four wires, straps or rods per luminaire, spaced approximately equidistant around. Do not support luminaires by acoustical tile ceiling panels. Where luminaires of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support each independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the luminaire. Provide wires, straps, or rods for luminaire support in this section. Luminaires installed in suspended ceilings must also comply with the requirements as indicated.

3.1.3 Ballasts, Generators and Power Supplies

Typically, provide ballasts, generators, and power supplies (drivers) integral to luminaire as constructed by the manufacturer.

3.2 FIELD APPLIED PAINTING

Paint lighting equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Provide painting as indicated.

-- End of Section --