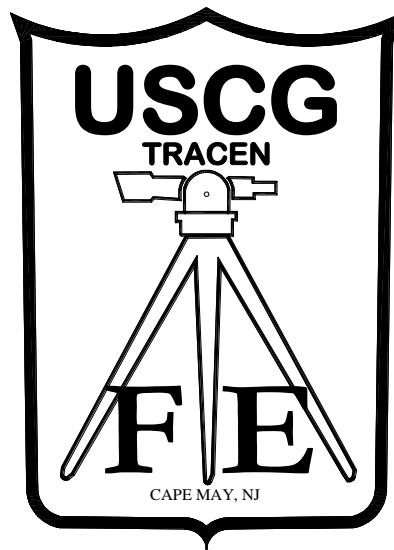


**TRAINING CENTER
CAPE MAY, NJ**

**FACILITIES ENGINEERING
DIVISION**



CMS-1576

Project No.: 12672868

June 2019

**SPECIFICATION FOR
GYM POOL VENTILATION UNIT
REPLACEMENT, RPFN 269
TRACEN CAPE MAY
CAPE MAY, NEW JERSEY**

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DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 11 00 SCOPE OF WORK

1. WORK INCLUDED: Work of the Project includes all materials, labor, equipment, services, and all operations necessary for the Replacement of the Pool Dehumidification Air Handler and Condenser at Building 269, United States Coast Guard Training Center (TRACEN) Cape May, New Jersey.
 - 1.1 Major work items include but are not limited to:
 - A. Provide and install New Direct Replacement PoolPak Air Handler and New Condenser. Part Number SWHP220SR-20E-CHF-R410 or equal. Equal unit shall meet the performance requirements indicated on the drawing schedule and shall work in tandem with PoolPak AHU-14. Specifically, each unit shall be 460 volts, three phase with a heating capacity of 689 MBH and cooling capacity of 566 MBH at a pressure of 1.75" WG. Fan shall provide air flow of 22500 CFM with 10% outside air;
 - B. Reuse electrical disconnects and feed wires for units. Electrical requirements and locations will be same as existing SWHP-220 PoolPak unit. For equal units, contractor shall modify electric disconnect and feed as necessary for equal unit;
 - C. Controls for units will be integrated into existing Building management system;
 - D. Demolish equipment as indicated on drawings, the intent is to use the existing lines sets and electrical connections for the new equipment. All equipment supports and ductwork shall remain and be utilized by new equipment. If contractor proposes an equal unit, modifications shall be provided as necessary to connect unit and provide a complete system;
 - E. Connections to existing ductwork will be performed under this contract. Any areas that are disturbed will be repaired and sealed;
 - F. Coordination of installation of equipment with TRACEN is imperative. The Pool Area will remain in operation during the replacement. There is another identical unit that will remain in operation during construction
 - G. Mobilization, demobilization and clean up;
 - H. Supervision, materials, equipment, transportation, labor and all other incidentals necessary to complete the work.

2. DRAWINGS: Drawings and the accompanying specifications are the property of the Government and comprise legal documentation that pertains exclusively to this project. Drawings will be made available in a format determined by the solicitation method. CEU Cleveland will not provide hard copies of drawings.

2.1 Construction Drawings:

T-7087-CD	TITLE SHEET	SHT 1 of 6
T-7088-CD	SITE MAP	SHT 2 of 6
T-7089-MD	EXISTING ROOF PLAN—CORE AREA	SHT 3 of 6
T-7090-MD	HVAC DEMOLITION & INSTALLATION PLAN	SHT 4 of 6
T-7091-MD	HVAC DETAILS	SHT 5 of 6
T-7091A-ED	ELECTRICAL	SHT 6 of 6

SECTION 01 11 16
WORK BY OTHERS

1. WORK NOT INCLUDED IN THE CONTRACT: Non-contractor personnel will accomplish the following work items necessary for completion of the project. However, the contractor must coordinate accomplishment of these work items with the appropriate parties noted below in accordance with Section 01 14 16, “Coordination”.
 - 1.1 Work by Utility Companies: South Jersey Gas Company will perform all natural gas connections to main service lines. Contractor shall pay all fees associated with this work.
 - 1.2 Work by other Contractors or Service Companies: Contractor personnel and equipment associated with another construction contract in progress may require access to the site during execution of this contract. The contractor shall coordinate work and ensure that work operations do not interfere with the contract currently in progress. The contractor shall allow service contract personnel access to the site for trash removal, snow removal, grounds maintenance or the performance of other related service contracts. The Coast Guard will advise the contractor of the trash removal, grounds maintenance or other recurring maintenance schedules.

SECTION 01 14 00
CONTRACTOR WORK HOURS

1. WORK HOURS: The Contractor will be permitted to perform construction work through the hours of 7:00 am and 4:30 PM Mondays through Thursdays. The Coast Guard base hosts recruit graduations on most Fridays year round. The contractor shall expect increased automobile and pedestrian traffic on Fridays. Excessive noise and other disruptive activities shall be limited on Fridays between the hours of 10:00 am

and 12:00 during graduation ceremonies unless otherwise approved by the COR. No major deliveries shall be scheduled between 8:00 and 12:00. Note any departures from these work hours on the Daily Reports.

2. SATURDAY, SUNDAY AND HOLIDAYS: The contractor shall provide the Contracting Officer's Representative at least forty-eight hours advance notice prior to working on weekends or Federal holidays. The Government may reject any such request without impacting the completion time of the contract.
3. CONTRACT COMPLETION: The contractor shall complete work within the time frame indicated upon issuance of the Notice to Proceed for Submittals. Limitations imposed by these work hours will not entitle the Contractor additional time to complete the project. Refer to FAR Clause 52.211-10 "Commencement, Prosecution and Completion of Work".
4. ACCESS TO BASE: Prior to commencement of the contract, the Contractor and all sub-contractors are required to register with the USCG TRACEN Cape May Security Office. Background screenings will be performed by TRACEN Security for all employees of the Contractor and sub-contractors working on the Base. The Contractor shall contact USCG TRACEN Cape May Security Office at (609) 898-6915 for detailed requirements.

SECTION 01 14 13 PRE-BID SITE VISITS

1. GENERAL: Bidders are responsible for visiting the site to field verify existing conditions and determine actual dimensions and the nature of the work required. Failure to visit the site does not relinquish the bidder from determining the extent and scope of the work required and estimating the difficulty and cost to complete the project. Requests for equitable adjustments, in either time or money, arising from failing to field verify site conditions may be denied. Provisions regarding the site visit requirements are outlined in FAR Clause 52.236-3 "Site Investigation and Conditions Affecting the Work".
2. SITE VISIT: During the Solicitation Phase of this Project, two Pre-Bid site visits will be scheduled by the Owner. The first Pre-Bid site visit will held approximately two weeks after the release of the Solicitation. The second Pre-Bid site visit will be held approximately three weeks after the release of the Solicitation. It is the responsibility of the contractor to contact the Project Engineer, LT Justin Davis, Facilities Engineering, Design Section, at (609) 898-6406 or Justin.S.Davis@uscg.mil to obtain the specific dates, as no other site visits will be scheduled.

SECTION 01 14 14 PRE-CONSTRUCTION SITE CONDITIONS

1. SITE CONDITION VERIFICATION: The Contractor shall verify the conditions of the

existing site, equipment and facilities potentially affected by the work under this contract. When designated on the submittal list, the contractor shall photograph and/or videotape the conditions in order to document their pre-construction condition. Copies of the photos and videos shall be submitted to the Contracting Officer prior to starting work.

SECTION 01 14 16 COORDINATION

1. INTERFERENCE WITH COAST GUARD OPERATIONS: Accomplish work in a manner that causes minimal impact on normal operations. The Contractor shall notify the Contracting Officer's Representative at least five working days in advance of any planned outages of water, electrical, telephone, or sanitary facilities. Notify the Contracting Officer's Representative at least one week prior to beginning construction.
2. TRAINING CENTER REGULATIONS:
 - 2.1 The Contractor, his employees, and subcontractors shall become familiar with and obey all Training Center regulations. All personnel employed on the project shall keep within the limits of the work and avenues of ingress and egress, and shall not enter any other areas outside of the site of the work unless required to do so in the performance of their duties. The Contractor's equipment shall be conspicuously marked for identification
 - 2.2 There shall be NO SMOKING in any Coast Guard building.
 - 2.3 Storage Areas: The Contracting Officer's Representative will determine exact location and boundaries of staging areas. Under no circumstances shall materials be stored in areas that will interfere with aircraft operations.
 - 2.4 Storm Protection: If a gale force wind warning or higher is issued, take precautions to minimize any danger to persons and protect the work and nearby Government property. Precautions shall include, but not be limited to, closings, removing loose materials, tools and equipment, from exposed locations. Remove and secure scaffolding and temporary work. Close openings in the work area if storms of lesser intensity are imminent.

SECTION 01 14 19 FIELD ADJUSTMENTS

1. The Contracting Officer's Representative may authorize field adjustments. Field adjustments are those alterations that do not affect time, price, or intent of the contract documents. All field adjustments shall be documented in the Daily Reports and on the As-Built Drawings.

SECTION 01 18 14
BUILDING PERMITS

1. NO BUILDING PERMITS from state or local governments are required for work performed on federal property.

SECTION 01 18 17
ENVIRONMENTAL PERMITS

1. Unless directed by other sections of this specification, the Contractor will not be responsible for obtaining environmental permits.

SECTION 01 26 13
REQUESTS FOR INFORMATION

1. SUMMARY:

- 1.1 Section Includes: Administrative requirements for requests for information.

2. DEFINITIONS:

- 2.1 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).

- 2.2 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.

- A. RFIs shall be sequentially numbered.

- B. Drawings shall be identified by drawing number and location on the drawing sheet.

- C. Specifications shall be identified by Section number, page and paragraph.

- 2.3 Improper RFIs: RFIs that are not properly prepared.

- A. Improperly prepared RFIs will not be processed by the Contracting Officer, but will be returned unprocessed.

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

- A. Frivolous RFIs may be returned unprocessed.

3. CONTRACTOR'S REQUESTS FOR INFORMATION:

- 3.1 During Bid Phase: Bidders shall submit all questions, in writing, to the Contracting Officer. Requests for Information (RFI) shall be submitted no later than five (5) business days prior to the bid due date. RFIs will be addressed by the USCG three (3) business days prior to the bid due date.
- 3.2 During Construction Phase: 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.
- A. 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, scanning 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.

4. CONTRACTING OFFICER’S RESPONSE TO RFIs:

4.1 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.

SECTION 01 31 19
PROJECT MEETINGS

- 1. LOCATION: Project meetings will be conducted either on-site or with a conference call. The following meetings may be held:

- 1.1 Pre-Construction Conference: After award of a contract, the Coast Guard will arrange a conference with the contractor, and necessary Coast Guard personnel. The purpose of this conference is to orient the Contractor to Government procedures for wage rates, contractual and administrative matters, and to discuss specific issues regarding actual construction.
- 1.2 Progress and Technical Review Meetings: These meetings generally take place at the project site. Either party may request a meeting to review the progress of the project and/or review or clarify the technical requirements of the specifications.

SECTION 01 32 16
CONSTRUCTION SCHEDULE, SCHEDULE OF VALUES,
AND PROGRESS SCHEDULE

1. In accordance with the Notice to Proceed letter, the Contractor shall submit the following:
 - 1.1 Construction Schedule-This schedule shall be prepared using a horizontal bar graph with time scale. It shall be in an industry accepted Project Management format and shall accurately display:
 - A. All major categories of work to be performed within the required contract completion date broken out in sufficient detail to track progress throughout the life of the contract. Major work categories should include but are not limited to mobilization, carpentry, plumbing, mechanical, electrical, roofing, concrete, site work, and demobilization. In addition to construction activities, procurement times for critical items, submittal turnaround time, mobilization, final inspection, punchlist work, and demobilization shall be shown on the schedule.
 - B. The duration of each work category.
 - C. Any concurrent work categories.
 - 1.2 Schedule of Values-This schedule shall be prepared as a **detailed** cost breakdown of the contract price and be submitted with the Construction Schedule. This schedule shall include but not be limited to costs of materials, equipment, and labor for all major work categories shown on the Construction Schedule. The Contractor shall adhere to the following guidelines when developing the Schedule of Values.
 - A. Format - The line items in the Schedule of Values shall be the same as that of the Construction Schedule.

- B. Bonds - Bonding costs will only be paid in a lump sum if they are broken out separately and included with the schedule of values. The Contractor shall provide evidence that he has furnished full payment to the surety.
 - C. 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.
2. **UPDATES:** Each month and /or with each progress payment request, the Contractor **shall** submit the following:
- 2.1 Progress Schedule-This schedule shall be an update of the Construction Schedule. It shall show the current schedule of all work.
- A. Modifications - If modifications are made to the contract, the work added shall be tracked separately from the original Construction Schedule and shall maintain its individuality on the Progress Schedule throughout the life of the contract. Progress Payment requests shall not lump modification costs into the original contract price.

SECTION 01 32 26
CONSTRUCTION DAILY REPORTS

1. **GENERAL:** The Contractor shall complete a Daily Report for each and every day after mobilization. The importance of an accurate, fully detailed Daily Report, promptly delivered to the designated On-Site Representative cannot be overemphasized. The report shall provide an accurate cumulative summary of the history and performance of the work. The Daily Report shall document weather; work hours; work in-place; inspections and tests conducted, and their results; dimensional checks; equipment and material checks; data on workers by classification; the mobilization and demobilization of construction equipment; materials delivered to the site; and any other pertinent noteworthy event; e.g., personnel injury, site visit by Coast Guard personnel, etc.
2. **RESPONSIBILITY:** The Daily Reports play an important role in settling disputes and claims for both parties. For this reason the On-Site Representative and the Contractor's Superintendent, together, should review the report to ensure its completeness and accuracy. Each day's report shall be submitted to the On-Site Representative no later than 10:00 a.m. the following morning. The maximum allowable retainage will be enforced for late, sporadic or non-submission of Daily Reports. In the absence of an On-Site Representative the Contractor shall mail the Daily Reports directly to the Contracting Officer every Friday. Should the Daily Report indicate an accident, environmental issue, OSHA violation or any crisis the On-Site Representative deems important, the Report should be faxed immediately to the Contracting Officer at (216) 902-6278.

3. DESIGNATED ON-SITE REPRESENTATIVE RESPONSIBILITY: After a Notice to Proceed for site work has been issued the On-Site Representative shall complete a Daily Report for each day until the Contractor mobilizes. After the Contractor is at the site, the On-Site Representative shall ensure that the Contractor completes the Daily Report in accordance with Paragraphs 1 and 2 above. Any items of dispute or other notes the On-Site Representative feels appropriate shall be added to the Daily Report. The On-Site Representative is also responsible for informing the COR when the contractor fails to submit daily reports.

SECTION 01 33 00
SUBMITTAL PROCEDURES

1. GENERAL: The Contractor shall submit to the COR and Contracting Officer, one (1) electronic copy in “.pdf” format of submittals required by this specification and/or itemized on the "List of Submittals" found at the end of this division.
2. REQUEST: A "CONTRACT ITEM ACCEPTANCE REQUEST" shall accompany all submittals. All items shall be individually listed and clearly identified, referencing the applicable Section and Paragraph. A copy of this form is located at the end of this division and may be reproduced as needed. Both sides of Contract Item Acceptance Request sheet shall be submitted. The sheet shall be signed and dated by the Contractor.
 - 2.1 The Contract Item Acceptance Request and the item information shall be consolidated into one .pdf file and one email. Email to the COR and Contracting Officer. Manage email size so as not to exceed the limit allowed by the Coast Guard system. If the email is rejected by the system, reduce the file size and resubmit.
 - 2.2 Up to eleven (11) items may be listed on an individual approval request. Number each Contract Item Acceptance Request consecutively (*Submittals # 1, 2, etc.*) and re-submittals with letters (*Submittal #1A is the first re-submittal of Submittal #1*).
 - 2.3 Submittals shall be forwarded to the COR and Contracting Officer. The contractor shall allow 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 Contract Item Acceptance Request as "Urgent" to request a 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.
3. DEVIATIONS
 - 3.1 Deviation from specification:

- A. The COR and Contracting Officer will consider requests for deviations/substitutions only if submitted within fifteen (15) calendar days after award.
 - B. Deviations may be considered when a product becomes unavailable through no fault of the Contractor.
 - C. The Contractor shall document each request with complete data substantiating compliance of proposed deviation with the Contract documents. *Request for deviation shall not be submitted on a Request for Information (RFI) form.*
 - D. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide the same warranty for deviation as for specified product.
 - 3. Will coordinate installation and make changes to other work which may be required for the work to be completed at no additional cost to the Government.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse the Government for review or redesign services associated with re-approval by the COR and Contracting Officer.
 - E. If the deviation has a lesser value than the product originally specified, the Contractor shall provide a credit to the Government.
 - F. Deviations will not be considered when they are indicated or implied on Shop Drawings or Product Data submittals, without a separate written request, or when acceptance will require revisions to the Contract documents.
- 3.2 Deviation submittal procedures:

- A. The Contractor shall mark the “Deviation” block on the Contract Item Acceptance Request (CIAR) form and provide the information stated in Paragraph 3.1 above.
- B. The Contractor shall submit shop drawings, product data, and certified test results attesting to proposed product equivalence. Burden of proof is on the Contractor.
- C. The COR and Contracting Officer will then review the “deviation” request and either accept or reject the deviation. The COR and Contracting Officer’s acceptance of the deviation signifies that the Contractor has provided the information required in Paragraph 3.1. If a credit is due the government, the Contracting Officer will notify the Contract Specialist and

the deviation will be processed utilizing the Change Request procedures for a modification to the contract/task order.

- D. The COR and Contracting Officer will notify the Contractor of acceptance/rejection of the deviation via an accepted or rejected CIAR. The Contracting Officer will notify the Contractor, in writing, if a modification to the contract is required.
 - E. If a request for deviation is received without the documentation stated above, the COR and Contracting Officer will return the submittal to the contractor for the required information.
4. **ACCEPTANCE:** Submittals will be stamped "Accepted, "Accepted with Comment", or "Resubmit". Accepted, Accepted with Comment or Resubmit for each item will be indicated on the Contract Item Acceptance Request form and one copy returned to the Contractor.
- 4.1 **Prompt re-submittal of items is required.** The Contractor shall furnish a new Contract Item Acceptance Request numbered in accordance with the requirements of paragraph 2.1.
 - 4.2 The actions taken by the Coast Guard are only for general conformity to the contract drawings and specifications and shall not relieve the Contractor from responsibility for error in dimensions and compliance with all terms stipulated by contract.
5. **DEFECTIVE WORK:** Approval of Submittals does not restrict the Government's right to reject departures from contract requirements, use of damaged or improperly installed items/materials, or latent defects, nor does it prejudice the Government's rights of rejecting any work found defective at Final Inspection and Acceptance.
- 5.1 Work started or completed prior to submittal acceptance is **solely** at Contractor's risk and may jeopardize contract performance.
6. **TYPES OF SUBMITTALS:** The paragraphs given below provide descriptions for each type of submittal that may be required within the individual sections of this specification. Refer to the Individual Sections themselves and the List of Submittals document for the required submittals.
- 6.1 **Product Data:** Submit pursuant to this section for review for conformance with contract.
 - A. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

- B. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- 6.2 Shop Drawings: Submit pursuant to this section for review for conformance with contract.
- A. Shop drawing submittals shall be drawings, diagrams, schedules and other data specially prepared for the work of this contract by the contractor or any subcontractor, manufacturer, supplier or distributor to illustrate a portion of work to be installed under this contract.
 - B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
 - C. When required by individual specification sections, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- 6.3 Samples: Submit pursuant to this section for review for conformance with contract.
- A. Samples For Selection as Specified in Product Sections:
 - 1. Submit to Contracting Officer's Representative for aesthetic, color, or finish selection.
 - 2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns.
 - B. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - C. Include identification on each sample, with full Project information.
 - D. Submit number of samples specified in individual specification sections.
 - E. Reviewed samples which may be used in the Work are indicated in individual specification sections.
 - F. Samples will not be used for testing purposes unless specifically stated in specification section.

- 6.4 Design Data: Submit pursuant to this section for review for conformance with contract.
- A. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- 6.5 Test Reports: Submit pursuant to this section for review for conformance with contract.
- A. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
 - B. The testing shall have been performed in a laboratory meeting the requirements specified herein. The tests shall have been performed within three years of submittal of the reports for approval. Test reports shall be accompanied by the certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacture, and make as tested.
- 6.6 Certifications: Manufacturer's certification furnished by the Contractor on items of materials and equipment incorporated into the work will be accepted only when this method will assure full compliance with the provisions of the contract. Pre-printed certificates will not be acceptable. All certifications shall be in the original. The original of all manufacturers' certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test data upon which the certifications are based. All certificates shall be signed by the manufacturer's official authorized to sign certificates of conformance or compliance.
- A. When specified in individual specification sections, submit certification.
 - B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- 6.7 Laboratory Reports: Reports shall cite the contract requirements, the test or analysis procedures used, the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a representative of the testing laboratory authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation.
- 6.8 Manufacturer's Instructions: When specified in individual specification sections,

submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing.

- A. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- 6.9 Manufacturer's Field Reports: When specified in the individual specification sections, submit Manufacturer's Field Reports on tests conducted by manufacturers. Reports shall cite the contract requirements, the test or analysis procedures used, the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by a representative of the testing laboratory authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation.
- 6.10 Manufacturer and Installer Qualifications: When specified in the individual specification sections, submit qualifications of the manufacturers or installers as required. Qualifications shall include a list of projects of similar nature and a list of five references, minimum, with all contact information. Additional references may be required upon request.
- 6.11 Manufacturer's Inspection Reports: When specified in the individual specification section, submit Manufacturer's Inspections Reports prepared by the Manufacturer's Field Representative. Reports shall cite name and contact information of inspector, date of inspection, time on and off the site, weather conditions at time of inspection, contractors on site, number of workmen, equipment, improvements installed, overall quality of work, deficiencies and other concerns, recommended corrective actions and any other information required by the manufacturer.

SECTION 01 35 29 SAFETY PROGRAM

1. **GENERAL:** The Contractor is wholly responsible for work site safety. The Contractor shall implement a safety program that protects the lives and health of personnel in the construction area, prevents damage to property, and avoids work interruptions. The Contractor shall provide appropriate safety barricades, signs, signal lights, etc. (see Section 01 56 00, "Lights, Signs & Barricades") as well as complying with the requirements of all applicable Federal, State and Local safety laws, rules and regulations.
2. **COMPLIANCE:** The Contractor is specifically required to comply with the requirements of the U. S. Army Corps of Engineers "Safety and Health Requirements Manual" (EM 385-1-1, latest version available) and the "Accident Prevention" clause

(FAR 52.236-13). Once accepted, this safety plan shall become part of the contract requirements. Note: This review/acceptance does not in any way relinquish the Contractor from responsibility for work site safety nor the obligation to comply with the OSHA regulations found in 29 CFR 1910 & 1926 or any other State or Local safety law, rule or regulation applicable to the contract work. The Coast Guard will cooperate fully with the Department of Labor (Occupational Safety and Health Administration) in their enforcement of OSHA regulations.

3. SAFETY PLAN: The Contractor shall submit a written safety plan. At a minimum, this plan shall describe the Contractor's general safety program and identify specific safety provisions for hazards incidental to the contract work; e.g., elevated working surfaces, working over water, working from floating work platforms, overhead crane operations, etc.

SECTION 01 40 00 QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. All work shall be in strict compliance with the manufacturer's instructions.
- C. When manufacturers' instructions conflict with Contract Documents, request clarification from Contracting Officer's Representative (COR) before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Upon request, the general contractor shall provide documented experience for all sub-contractors, manufacturers and applicators utilized as part of this contract.
- G. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

- I. Use adequate numbers of skilled work personnel who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of all work covered under this specification.
- J. The general contractor shall coordinate the work of all trades to insure no conflicts occur that will prevent a complete operational installation.
- K. All materials and methods of construction for building work shall comply with the International Building Code, latest edition. The contractor and his/her subcontractors shall be responsible to familiarize themselves with this document.
- L. All materials and methods of construction for site work shall comply with the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction, 2001, with revisions, hereon referred to as the NJDOT Specifications. The contractor and his/her subcontractors shall be responsible to familiarize themselves with this document.
- M. Comply with the latest edition of all applicable code requirements, including:
 - 1. NFPA 101: Life Safety Code
 - 2. Uniform Federal Accessibility Standards
 - 3. ASCE 7-05: "Minimum Design Loads for Buildings and Other Structures"
 - 4. National Electric Code (NEC)
 - 5. ASHRAE Manual
 - 6. Other applicable codes and industry standards

1.2 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Contracting Officer's Representative before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.3 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

- B. Conform to reference standard, by date of issue, current on date of Contract Documents, except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Contracting Officer's Representative before proceeding.
- E. Contractual relationships, duties, and responsibilities of parties in Contract and those of Contracting Officer's Representative shall not be altered from Contract Documents by mention or inference otherwise in Reference documents.
- F. The Contracting Officer has sole authority to approve or authorize any changes to the contract, particularly those that impact money or time.

1.4 LABELING

- A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approving agency identification, and the following information, as applicable, on each label.
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.

1.5 TESTING AND INSPECTION SERVICES

- A. Terminology
 - 1. Factory Tests: Tests made on various products and component parts prior to shipment to the job site, including but not limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.
 - 2. Field Test: Tests or analysis made at, or in the vicinity of the job site in connection with the actual construction.
 - 3. Products: The term "product" includes the plural thereof and means a type or a category of manufactured goods, construction, installations and processed materials or those associated services whose characterization, classification or functional performance determination is specified by standards.
 - 4. Person: The term "person" means associations, companies corporations, educational institutions, firms, government

agencies at the Federal, State and local level, partnership, and societies, as well as divisions thereof, and individuals.

5. Testing Laboratory: The term "testing laboratory" means any person, as defined above, whose functions include testing, analyzing, or inspecting "products", as defined above, and/or evaluating the designs or specifications or such "products" according to the requirements of applicable standards.
6. Certified Test Reports: Certified reports, performed by a testing laboratory regularly engaged in the business, attesting that the tests were performed in accordance with the method specified, that the results reported are accurate, and that items tested either meet or fail to meet the stated minimum requirements. Those test reports include tests performed by Factory Mutual, Underwriters Laboratories, Inc., and others.
7. Certified Inspection Reports: Certified inspections reports are those signed by approval inspectors attesting that the item inspected meets the specification requirements other than any exception included in the report.
8. Manufacturer's Certificate of Conformance or Compliance: A certificate signed by an authorized manufacturer's official attesting that the material or equipment delivered meets the specification requirements.
9. Contractor's Daily Report: A report of man-hours expended work accomplished, etc., filled out on a daily basis by the Contractor's Job Superintendent and submitted to the Contracting Officer's Representative.

- B. Employ the services of an independent testing agency or laboratory acceptable to The Government to perform specified testing.
 1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered Engineer or specialist and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.
- C. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Contracting Officer's Representative.
 1. Laboratory: Authorized to operate in State of New Jersey.
 2. Laboratory Staff: Maintain full time registered Engineer or specialist on staff to review services.
 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

- D. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Contracting Officer's Representative.
- E. Reports will be submitted to the Contracting Officer and Contracting Officer's Representative, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
 - 1. Submit final report indicating correction of Work previously reported as non-compliant.
- F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Contracting Officer's Representative and independent firm 24 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- G. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- H. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Contracting Officer's Representative.
- I. Testing Laboratory Responsibilities:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Contracting Officer's Representative and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Contracting Officer's Representative and Contractor of observed irregularities or non-conformance of Work or products.
 - 6. Perform additional tests required by Contracting Officer's Representative.
 - 7. Attend preconstruction meetings and progress meetings, when requested.
- J. Testing Laboratory Reports: After each test, promptly submit two copies of report to the Contracting Officer, and one copy to the Contracting Officer's Representative, Contractor, and authority having jurisdiction.

When requested by Contracting Officer's Representative, provide interpretation of test results. Include the following:

1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance with Contract Documents.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

- A. **QUALITY CONTROL REQUIREMENTS:** Inspect and test all work under the contract and maintain records of the inspections and tests. Approvals, except those required for field applications, and field test, shall be obtained before delivery of materials and equipment to the site. Surveillance of the inspection system will be performed by the Contracting Officer Technical Representative.
1. **Factory Tests:** Unless otherwise specified, the Contractor shall arrange for factory tests when they are required under the contract.
 2. **Factory Inspection:** Unless otherwise specified, the Contractor shall arrange for factory inspections when required under the contract.
 3. **Field Inspections and Tests by the Contractor:** The Contractor shall furnish all equipment, instruments, qualified personnel and facilities necessary to inspect all work and perform all tests required by the contract. All inspections and tests performed and test results received each day shall be included in the Daily Report to the Inspector.
 4. **Field Inspections and Tests by the Government:** Field inspections and tests conducted by the Government will be made in accordance with FAR 52.246-12 entitled Inspection of Construction.
 5. **Approved Testing Laboratories:** All laboratory work under this contract shall be performed by a laboratory approved by the Government, whether the laboratory is employed by the Contractor, or is owned and operated by the Contractor. The basis of approval includes the following:

- a. Testing Laboratories performing work not in connection with concrete, steel, or bituminous materials shall comply with sections 3 and 4 of ASTM E329, except that the Contracting Officer will perform the functions of paragraphs 3.4 and 3.5 therein in the absence of other Government approval.
6. Repeated Tests and Inspections: Repeat tests and inspections after corrections have been made to nonconforming materials and workmanship until tests and inspections indicate the materials, equipment, and workmanship conform to the contract requirements. The re-testing and re-inspections shall be performed at no additional cost to the Government.

3.2 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.3 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.4 DAILY REPORTING

- A. Submit the "Contractor's Daily Report" through the Contracting Officer's Authorized Representative by 10:00 AM on the first working day following the day the work was performed. The report shall be filled out and submitted by the Contractor's Job Superintendent. A sample format of an acceptable form is included at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample. DAILY REPORT FORMS WILL

NOT BE SUPPLIED BY THE COAST GUARD; AN ELECTRONIC COPY OF THE FORM WILL BE PROVIDED UPON REQUEST.

SECTION 01 51 00
TEMPORARY UTILITIES

1. GENERAL: All temporary utility connections shall be compatible with existing materials and equipment to provide safe and efficient installation, operation and removal.
2. ELECTRICITY: The Contractor may utilize electrical power from the nearest electrical receptacle or panelboard, subject to availability. OSHA requirements will govern the use of such utility. All equipment used shall be supplied by the Contractor. US Coast Guard does not make any guarantee against any voltage variation or service interruption.
 - 2.1 Utility Outages and Shutdown: Needed power outages shall be arranged only with prior approval from Contracting Officer's Representative (COR), with duration and affected areas held to a minimum.
3. TELEPHONE: Telephone services will not be available for use by the Contractor.
4. WATER HOOKUP: Water will be made available at the nearest hydrant or exterior hose bib. All connections to the water system shall be equipped with back flow protection. Temporary potable water pipes and hoses shall be sterilized before being placed in operation and every time the system is opened to the atmosphere for repair or relocation.
5. SANITARY FACILITIES: It shall be the Contractor's responsibility to furnish and maintain approved portable toilet facilities for all Contractor personnel. The On-Site Representative will designate the physical location for the facility and the Contractor shall maintain the toilet facility to the satisfaction of the Government. Contractor personnel are forbidden to use toilet facilities within existing buildings.

SECTION 01 51 13
EQUIPMENT/UTILITY LOCKOUT AND TAGOUT REQUIREMENTS

1. GENERAL: The Contractor shall comply with OSHA 29 CFR 1910.147, "The Control of Hazardous Energy" (Lockout/Tagout). The Contractor shall provide a Lockout/Tagout Plan to the Contracting Officer prior to starting any work affected by the energy in the equipment/utility system.
2. APPLICATION: The Contractor shall be responsible for locking out and tagging out of service, all equipment/utility systems involved in the work under this contract. After the Contracting Officer's Representative has approved an outage, Government personnel and the Contractor shall independently secure the equipment/utility system

and tag the respective system out of service. The Contractor shall provide their own locks and chains that are required to secure the equipment/utility systems; e.g., steam, water, air, and/or electricity.

SECTION 01 51 16
TEMPORARY FIRE PROTECTION

1. TEMPORARY FIRE PROTECTION: Install and maintain temporary fire-protection facilities to protect against predictable and controllable fire loss. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".

1.1 HOT WORK PERMIT

- A. Prior to performing "Hot Work" (welding, burning, lead melting, blowtorches, tar pots, etc.) or operating other flame-producing devices, the contractor shall request a Hot Work permit. This permit will be issued by the Training Center Fire Department through the Contracting Officer's Representative (COR). This permit will be issued only after job site inspection by a member of the Fire Department for a specific task.
 1. All Hot Work will be shut down 30 minutes before the end of work and a fire watch shall be kept at the scene of operation during this 30 minutes.
 2. Extinguishers and Fire Watch Personnel: The contractor shall furnish, in accordance with all applicable requirements of the NFPA (National Fire Protection Association) Standards, sufficient fire extinguishers and fire watch personnel to protect the area in which his work is being performed. The size and type of fire extinguisher used will be subject to review by the Training Center Fire Department through the COR.

1.2 BURNING

- A. The burning of trash or other waste material shall be prohibited.

1.3 HEATING

- A. All sources of temporary heat shall carry an "Underwriters Laboratory" label and portable heaters shall be located to avoid ignition of combustible materials.
- B. Electrical heaters shall not be connected to extension cords.
- C. Open drumfires are prohibited.

1.4 ELECTRICAL

- A. All portable electric devices (saws, sanders, compressors, lights, extension cords) not required to be left on shall be disconnected at the close of work each day.
- B. All wires plugged into electrical outlets shall be equipped with male plugs. The inserting of the bare ends of wires into outlets is prohibited.

1.5 FLAMMABLES

- A. Oil painting materials (paint, brushes, empty paint cans, rags, paint clothes, drop cloths, etc.) and flammable liquids shall be removed from the building at the close of work each day.
- B. Highly flammable liquids such as paints, thinner, etc. that are to be kept inside buildings shall be held to an absolute minimum except in buildings authorized and designed for such storage.
- C. Storage of gasoline in excess of (5) gallon containers shall be permitted only by specific approval from the Training Center Fire Chief through the Contracting Officer's Representative.
- D. All storage areas containing flammable liquids shall be marked with signs indicating "FLAMMABLES" and "NO SMOKING".

1.6 FIRE HYDRANTS

- A. Fire hydrants shall not be used without approval of the Training Center Fire Department through the Contracting Officer's Representative. Where permission is granted for the use of fire hydrants, the contractor shall be required to furnish a gate valve and backflow preventer to fit the 2 1/2-inch outlets.
- B. The Training Center Fire Department through the Contracting Officer's Representative will have control of the opening and closing of fire hydrants.
- C. A clear space of 15 feet on both sides of fire hydrants shall be maintained at all times.

1.7 EXISTING FIRE DEVICES

- A. Fire hose or extinguishers in existing buildings shall not be removed from their locations, unless specifically indicated to be relocated or removed by the plans and specification for the project. No fire hose or extinguishers shall be used for any purpose other than combating a fire.

1.8 SMOKING:

- A. Smoking is strictly prohibited in all Government buildings. Smoking is only permitted in designated smoking areas. There shall be NO SMOKING or unsupervised open flame permitted inside any structure, temporary or permanent; nor within 25 feet of combustible material or within 50 feet of flammable liquids or compressed gasses.

1.9 FIRE REPORTING

- A. All contractors providing office space or trailers with telephone service shall place or post the fire reporting phone number by the phone. All contractor personnel shall be instructed how to report a fire. Any fire, no matter how small, shall be reported, including those already extinguished, to the Training Center Fire Department immediately. If a Training Center telephone is used, dial extension 6333. If any other telephone is used, dial 911.

SECTION 01 52 13
FIELD OFFICES

- 1. OFFICE AND STORAGE SHED: A field office for the COR is not required. The Contractor shall provide his own office and storage shed or trailer, if necessary. No equipment or material storage will be provided by the Coast Guard. Locations of the office and sheds shall be provided by the COR at the Pre-Construction meeting.

SECTION 01 55 00
ACCESS ROADS AND PARKING

- 1. ACCESS: Access to the site is available from public roads. Any damage to these roads by the Contractor's vehicles shall be repaired without cost to the Government.
- 2. PARKING: Vehicular operations and parking shall comply with all applicable government orders and regulations. All driveways and entrances serving the Government shall be kept clear and available to emergency vehicles at all times.
- 3. VEHICLE AND VEHICLE OPERATION: All vehicles, owned by the Contractor or employees of the Contractor, and operators of these vehicles, shall meet all state regulations for safety, noise, loading and minimum liability insurance. All vehicle operators demonstrating reckless or careless operation in the opinion of the Government shall not be allowed to operate vehicles on government property for the duration of the contract.
- 4. VISITORS: No visiting vehicles will be permitted on government property unless the operator is employed by a subcontractor or supplier.

SECTION 01 55 29
STAGING AREAS AND ACCESS

1. LOCATION: The Contractor shall store materials and operate equipment within the confines of the staging area identified by the Government. Storage of materials outside of the staging area will not be permitted. A lay down and parking area for Contractor's vehicles, trailers and personnel will be designated by the Contracting Officer's Representative at the Pre-construction meeting.
2. COORDINATION: Obey all U.S. Coast Guard Parking Signs and traffic rules. Vehicles shall not travel or park on grass. If travel or parking on grass is necessary, grass shall be restored to original condition after completion of the project at no cost to the Government.
3. ADJACENT AREAS: The Contractor shall ensure that all land and vegetation adjacent to the staging area and access drive remain undisturbed and undamaged; all damages shall be repaired at no cost to the Government.

SECTION 01 56 00
LIGHTS, SIGNS & BARRICADES

1. GENERAL: The contractor shall provide and maintain all warning lights, sign, and barriers to insure the safety of pedestrians or vehicles traveling near or through any hazardous area caused by the execution of the Contract work.
 - 1.1 BARRICADES: Any stored debris, equipment and all areas dangerous to foot or vehicular traffic shall be barricaded by the Contractor. At night and during other times of poor visibility, barricades shall be illuminated. All barricading, including night illumination shall be maintained by the Contractor. All barricades shall be constructed in accordance with ANSI D6-1.
 - 1.2 PEDESTRIAN TRAFFIC: The Contractor shall arrange his equipment and/or progression of work, so as not to interfere with the normal flow of pedestrian traffic. Where interference is unavoidable, the contractor shall provide a marked, safe, and clean route around the obstruction
 - 1.3 BARRIERS
 - A. Provide barriers to prevent unauthorized entry to construction areas to protect existing facilities and adjacent properties from damage from construction operations and demolition.
 - B. Provide protection for plants designated to remain. Replace damaged plants.
 - C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

SECTION 01 57 23
POLLUTION CONTROL

1. VOLATILE ORGANIC COMPOUND (VOC) REGULATIONS: Contractors are required to comply with local, state and federal VOC compliance laws and regulations in the foregoing order of precedence. In order to comply with the provisions of the Clean Air Act, each state must have a State Implementation Plan. Some contractors may be required to abide by the provisions of a Title V Permit. Some contractors may be required by state or local law to operate under the terms of a Compliance Plan to reduce VOC Emissions.
 - 1.1 In accordance with the Notice to Proceed Letter, the contractor will submit copies of any local, state or federal implementation plans, permits or compliance plans required/applicable to the use/application of VOCs at contractor's facility or offsite work places.
 - 1.2 If no local, state or federal implementation plans, permits or compliance plans are required/applicable to the use/application of VOCs, then the contractor shall submit to the designated Contracting Officer a letter, notarized under oath, that such documents are not required.

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 4 GENERAL

4.1 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from same manufacturer for components being replaced.

4.2 PRODUCT DELIVERY REQUIREMENTS

- A. RECEIPT OF MATERIALS: Shipments of equipment, materials, and supplies shall be addressed to the Contractor - not the Coast Guard. The contractor shall provide all equipment, materials and labor for off-loading. The Coast Guard will not accept shipments for the Contractor.

- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- D. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

4.3 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

4.4 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

4.5 PRODUCT SUBSTITUTION PROCEDURES

- A. The Contracting Officer (KO) will consider requests for Substitutions only within 15 calendar days after date established in Notice to Proceed.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other work which may be required for the Work to be complete with no additional cost to the Government.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse the Government for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. If the substitution has a lesser value than the product originally specified, the Contractor shall provide a credit to the Government.
- F. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- G. Substitution Submittal Procedure:
 - 1. Submit four (4) copies of Request for Substitution to the KO for consideration. Submit one (1) copy to the Contracting Officer's Representative (COR). Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. The COR will notify the KO/KSP in writing of recommendation to accept or reject request.
 - 4. The KO will notify Contractor in writing of decision to accept or reject requests. The KO will notify the contractor in writing if modification to the contract is required.

SECTION 01 65 00
RECOVERED MATERIALS NOTICE

1. GENERAL: It is the intent of Training Center Cape May to comply with the requirements of Section 6002 of the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act (RCRA or the Act) as amended, 42 U.S.C. 6962 and Executive Order 12873 as they apply to the procurement of the materials designated in paragraph 2.
2. DESIGNATED RECOVERED MATERIALS: It is the purpose of this section to designate items that are or can be made with recovered materials. These designated items can be found at <https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program#products>.
3. CONTRACTOR RESPONSIBILITY: The contractor should provide recycled materials to the extent practical, provided the materials meet all other requirements of the applicable specification section.

SECTION 01 66 13
HAZARDOUS WASTE

1. GENERAL: The Contractor shall comply with all federal, state, and local environmental regulations dealing with the generation, management, storage, and disposal of solid, toxic, and hazardous wastes. The Contractor shall ensure that all wastes are properly containerized, labeled and placarded, managed, tested, stored, documented/manifested, transported and disposed of in accordance with all applicable regulations. The manifest for all hazardous waste shall be signed by an authorized Coast Guard representative.
2. USED ELECTRIC LAMPS: 40 CFR 273 requires that electric lamps, including incandescent, fluorescent, neon and high intensity discharge (mercury vapor, high/low pressure sodium, metal halide) lamps that are no longer of use be recycled or treated as universal waste. The Contractor shall not dispose of any used electric lamps as solid waste. The Contractor shall recycle all waste electric lamps generated as a result of this work only at a licensed recycling facility.
3. RECYCLABLES: Recycling is a mandatory law of the State of New Jersey.
 - A. At the discretion of the COR, certain items of copper (including insulated cable), aluminum and steel shall remain the property of the Training Center. The Contractor shall separate and deliver these materials to a location at the Training Center designated by the COR. The Contractor shall place these materials in their respective bins or dumpsters.
 - B. The contractor shall recycle or reuse all other material designated as

recyclable or prohibited from landfilling. Definitions for recyclables and landfill prohibited material can be obtained from the CMCMUA regulations.

4. SUBMITTALS: The Contractor shall provide the Contracting Officer with signed and fully executed originals of all hazardous waste profiles, test results, hazardous waste manifests and/or other shipping papers, electric lamp disposal documents and all other required documentation. Maximum payment retention shall be withheld until this documentation is received.

SECTION 01 66 16 SAFETY DATA SHEETS AND MATERIAL HANDLING PROCEDURES

1. DATA SHEETS: Submit a Safety Data Sheet (SDS) for all materials containing hazardous substances required for contract execution. Information provided in SDS's shall meet the requirements of 29 CFR 1910.1200. SDS's require Contracting Officer review and acceptance prior to bringing these materials on site.
2. MATERIAL STORAGE: Limit the quantity of these materials stored on site to the amount needed for execution of work. Storage of excess materials will not be permitted. Assure that the storage of these materials comply with all applicable federal, state, and local laws and regulations and provide additional storage facilities (paint lockers, etc.) as required for the storage of such materials. Coordinate the physical location of storage areas with the On-site Representative prior to bringing these materials on site.
3. PROTECTIVE MEASURES: The contractor shall take all protective measures outlined on the SDS's and as required by federal, state, and local regulations to protect all personnel in the vicinity of the work area from exposure to these materials. The Contractor shall include any required protective measures in the Safety Plan (See Section 01 35 29, "Safety Program"). The Contracting Officer's Representative shall review protective measures prior to allowing use of these materials.
4. DISPOSAL OF EXCESS MATERIAL: The Contractor shall dispose of all excess hazardous materials as required by the SDS and all applicable federal, state, and local laws and regulations.

SECTION 01 71 33 PROTECTION FROM WEATHER AND CONSTRUCTION OPERATIONS

1. TEMPORARY ENCLOSURES: Protect existing facilities/equipment and new construction, whether in progress or newly completed, from the adverse effects of the weather and construction operations. Provide temporary enclosures, coverings and barriers as required to afford protection against exposure, weather and wind damage and from construction operations which could degrade, stain, age, or reduce the finished quality of new work or damage existing facilities and equipment.

2. CONTRACTOR'S STAGING AND STOCKPILING: The Contractor is responsible for the protection and use of materials for the project inside or outside the facility, including his dumpster and spot a pot used on site. Should the USCG notify the Contractor of a weather emergency such as an impending Hurricane, the Contractor will need to tie-down or move these temporary facilities to higher ground. Hurricane season is from June 1 - November 30.
3. REAPPLICATION: All temporary closures or enclosures shall be made ready for immediate re-application in the event of sudden storms or man-made conditions requiring protection of existing facilities or completed construction.
4. CLIMATE CONTROL: Where temporary heat is required during construction to protect work completed or to heat facilities in operation by the Coast Guard, all openings shall be made weather tight to allow the maintenance of 68 degrees F heat minimum with the existing or temporary heating equipment or 78 degrees F. maximum with existing or temporary cooling. NOTE TO OFFEROR: CLIMATE CONTROL SPECIFICALLY REQUIRED BY THIS CONTRACT WILL BE SPECIFIED IN THE STATEMENT OF WORK AND/OR ASSOCIATED DRAWINGS.
5. PIPING: Prevent water-filled pipes or tanks from freezing for both interior and exterior systems installed or in storage.

SECTION 01 74 00
GENERAL CLEANUP & SITE RESTORATION OF WORK AREAS

1. GENERAL: The Contractor shall remove and properly dispose of all trash and debris incidental to the contract work from the limits of government property, as well as all adjacent affected areas. The Contracting Officer shall determine the extent and interval of these cleanups.
2. WORK AREA CLEANUP: At end of each day the entire work area and all adjacent affected areas shall be thoroughly cleaned by removing all trash, debris, dust, etc. caused by the contract work. Any floor, wall or ceiling surfaces that may have been stained or soiled by the contract work shall be restored to pre-construction condition.
3. SITE RESTORATION: If at any time while performing the contract the Contractor causes damage or destruction to any portion of any Government facility or grounds; e.g., bulkheads, pavement, lawns, shrubbery, etc., it shall be the Contractor's responsibility to replace and/or restore the damage as approved by the Contracting Officer's Representative at no additional cost to the Government.
4. POST CONSTRUCTION CLEANUP: Upon completion of the job, the Contractor shall clean up the job site, returning it to a state of cleanliness equal to or exceeding that in which it was found. The Contractor shall properly dispose of any trash, extra materials, dirt, debris, or other litter that remains. If the job site appearance is not to the satisfaction of the Contracting Officer's Representative, final acceptance will not be approved.

SECTION 01 78 00
AS BUILT DRAWINGS

1. GENERAL: Maintain one full size set of contract drawings to record variations from the original design. **All deviations shall be neatly and clearly marked in RED** on these drawings to show work and/or materials actually provided. As Built drawings shall be **updated** as work progresses and kept at the work site for the duration of the contract. These drawings shall be available for Contracting Officer Representative review upon request.
2. DISCOVERED UTILITIES: Indicate the exact location and depth of any **underground utility lines discovered in the course of the work** on the As-Built drawings.
3. PERMITTED VARIATIONS: As Built drawings shall reflect the actual construction and materials provided when alternative materials or work methods are allowed in the specifications and/or drawings or if the scope is altered by award of bid items, subsequent changes or modifications.
4. STANDARDS: Variations shown on As Built drawings shall be neat, clear and conform with standard drafting practices. Mark-ups shall include supplementary notes, legends, and details necessary to convey the exact representation of construction actually provided. As Built drawings shall be clearly labeled "AS-BUILT" and dated.
5. SUBMITTAL: Submit one ".pdf" digital copy and one ANSI D sized (22"x34") paper copy of the As Built drawings for Contracting Officer and COR acceptance upon completion of the contract. **Final payment will not be until all required As-Built drawings are accepted.** Maximum retention shall be withheld for late or incomplete As Built drawings.

SECTION 01 78 23
OPERATING INSTRUCTIONS AND TRAINING

1. MANUALS: Upon completion of the work, but before the work is accepted by the Government, the Contractor must forward one (1) .pdf file and one (1) complete bound set of instructions, tabbed and identified for reference, for all equipment and/or systems provided under this contract. The instructions shall include component parts, manufacturer's certificates, warranty slips, parts lists, descriptive brochures, and manufacturer's maintenance and operating instructions as indicated below.
 - 1.1 Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.
 - 1.2 Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

- 1.3 Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- 1.4 Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- 1.5 Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - A. Part 1: Directory, listing names, addresses, and telephone numbers of Contracting Officer's Representative, Contractor, Subcontractors, and major equipment suppliers.
 - B. Part 2: Operation and maintenance instructions arranged by process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 1. Significant design criteria.
 2. List of equipment.
 3. Parts list for each component.
 4. Operating instructions.
 5. Maintenance instructions for equipment and systems.
 6. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - C. Part 3: Project documents and certificates, including the following:
 1. Shop drawings and product data.
 2. Air and water balance reports.
 3. Certificates.
 4. Photocopies of warranties
2. **TRAINING:** When requested by the COR, the Contractor shall provide up to two hours of training, which shall explain to the Government's personnel all procedures necessary to operate and maintain all equipment and systems on a continuing basis. A verification of training shall be provided.

SECTION 01 80 00
FACILITY PREVENTATIVE MAINTENANCE PROGRAM (FPMP)

1. **GENERAL:** 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.

- 1.1 At a minimum, the following items require UNIFORMAT II Level 4 designations if the components are used in the contract.
 - A. Plumbing Systems//
 - B. HVAC Systems//
 - C. Electrical Systems//
 - D. Fire Alarm Systems//
 - E. Fire Suppression Systems//
 - F. Water Systems//
 - G. Compressed Air and Piping Systems//
 - H. Carpet Care, Flooring and Cleaning//
 - I. Battery Systems//
 - J. Any machinery or equipment installed as part of this contract//
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.
 - 2.1 ASTM E 1557: Standard Classification for Building Elements and Related Sitework – UNIFORMAT II
3. **SUBMITTALS:** Submit hard copy prints and electronic MS-Excel files of Equipment Enrollment Form (EEF) for Contracting Officer acceptance upon completion of the contract for each Real Property asset that has equipment to be enrolled as part of the FPMP.
 - 3.1 Equipment Enrollment Form (EEF) Requirements:
 - A. 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.
 1. UNIFORMAT II Level IV Classification
 2. Component Type (Assigned from USCG Approved Equipment Enrollment Catalog (column D))
 3. Physical Location, broken down by Floor, and Room #.
 4. Manufacturer Name
 5. Model Number
 6. Serial #

7. Installation Date
 8. Purchase Price (Cost of equipment, labor, shipping)
 9. Replacement Costs (Cost of equipment only)
 10. Warranty Expiration Date
 11. Equipment Attributes (Name Plate information typically indicating Size, Flow, Volume, Pressure, etc.)
- B. Only equipment from a single building and/or structure is allowed per Equipment Enrollment Form (EEF).
- C. 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 for the proper naming convention

LIST OF SUBMITTALS, CONTINUED

HS-USCG TRAINING CENTER CAPE MAY, NJ		CONTRACT ITEM ACCEPTANCE REQUEST		
Contract Number		Submittal Number	Submittal New Re-submittal	Date
Project Number			CONTRACTOR MARK IF DEVIATION FROM SPECIFICATIONS	FOR GOVERNMENT USE ONLY
Item No.	Specification Sect. & Para.	DESCRIPTION OF MATERIAL (Include Type, Model No., Catalog No., Mfg., etc.)	Deviation	Status
Contractor		By: (Signature and Date)		
Request as indicated above was received in this office on _____				
Recommend Acceptance or Resubmit as indicated above and subject to any applicable comments.				
Name and Grade		Signature		Date
Acceptance or Resubmit as indicated above and subject to any applicable comments.				
Name and Grade		Signature		Date

Status Abbreviation Guide: AC-Accepted; AC w/CMT-Accepted with Comment; R-Resubmit

DIVISION 02 – EXISTING CONDITIONS

SECTION 02 41 21 SELECTIVE EXTERIOR DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolishing designated building equipment and fixtures.
 - 2. Demolishing designated construction.
 - 3. Cleaning and sanitizing designated equipment.
 - 4. Cutting and alterations for completion of the Work.
 - 5. Removing and storing designated items for reuse.
 - 6. Protecting items designated to remain.
 - 7. Removing demolished materials.

1.2 GENERAL REQUIREMENTS

- A. Do not begin demolition until authorization is received from the Contracting Officer.
- B. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials.
- C. Remove rubbish and debris from the project site; do not allow accumulations outside the building.
- D. Remove rubbish and debris from Government property.
- E. In the interest of occupational safety and health, perform the work in accordance with O.S.H.A., US Army Corp of Engineers and ASSE/SAFE requirements and other applicable regulations.

1.3 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
- B. Demolition Plan
- C. Recycling Plan
- D. Receipts: Receipts or bills of lading.

1.4 REGULATORY AND SAFETY REQUIREMENTS

- A. Comply with federal, state, and local hauling and disposal regulations.
- B. Comply with the following safety regulations in addition to the regulatory OSHA requirements:
 - 1. Occupational Safety and Health Act (OSHA) 29 CFR 1910.
 - 2. U.S. ARMY CORPS OF ENGINEERS (USACE): EM 385-1-1 (2003) Safety and Health Requirements.
 - 3. American Society of Safety Engineers (ASSE/SAFE): ASSE/SAFE A10.6 (1990; R 1998) Safety Requirements for Demolition Operations.

1.5 DUST AND DEBRIS CONTROL

- A. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Sweep roof deck often to control the spread of debris that may result in foreign object damage potential to pedestrians and automobiles.

1.6 PROTECTION

- A. Traffic Control
 - 1. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades. Anchor barricades in a manner to prevent displacement by wind. Notify the Contracting Officer Technical Representative (COTR) prior to beginning such work.
- B. Existing Conditions Documentation
 - 1. Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the COTR showing the condition of structures and other facilities adjacent to areas of removal. Photographs sized 4 inch will be acceptable as a record of existing conditions.
- C. Items to Remain in Place
 - 1. Take necessary precautions to avoid damage to existing items to remain in place. Repair or replace damaged items as approved by the COTR. Coordinate the work of this section with all other work indicated. Ensure that structural elements are not overloaded. Do not overload structural elements. Repairs require approval by the COTR prior to performing such work.
- D. Existing Construction Limits and Protection
 - 1. Do not disturb existing construction beyond the extent indicated or necessary for installation of the new roof system. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.
- E. Weather Protection
 - 1. Protect building interior, materials, and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workers ready to provide temporary covering of exposed areas.
- F. Protection of Personnel
 - 1. Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the area being demolished and take immediate action to protect all personnel working in and around the project site.

1.7 ENVIRONMENTAL PROTECTION

- A. Comply with the Environmental Protection Agency requirements specified.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

- A. Inspect and evaluate existing materials for recycling. Removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for recycling or other disposal.

- B. Miscellaneous Metal
 - 1. Salvage shop-fabricated items such as framing, flashing and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as metal gutters, roofing and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.
 - C. Carpentry
 - 1. Salvage for recycle lumber and sort by type and size. Recycle salvaged wood unfit for reuse.
- 3.2 CLEANING OF ROOF TOP EQUIPMENT
- A. Bird Manure
 - 1. Wet surface thoroughly to reduce dust.
 - 2. Scrape manure off equipment.
 - 3. Collect manure and deposit in a secure plastic bag or container.
 - 4. Clean residue with soap and water.
- 3.3 DISPOSITION OF MATERIAL
- A. Unsalvageable and Non-Recyclable Material
 - Remove and dispose of unsalvageable and non-recyclable noncombustible and combustible material off site.
- 3.4 CLEANUP
- A. Remove debris and rubbish from site. Remove and transport the in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.
- 3.5 DISPOSAL OF REMOVED MATERIALS
- A. Regulation of Removed Materials:
 - Dispose of debris, rubbish, scrap, and other non-salvageable materials resulting from removal operations with all applicable federal, state and local regulations. Storage of removed materials on the project site is prohibited.
 - B. Removal from Government Property:
 - Transport waste materials removed from demolished and deconstructed structures from Government property for legal disposal.

END OF SECTION

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 05 53 IDENTIFICATION FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Installation of identifying devices shall occur prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm)high.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: 1-1/2 inch diameter, Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as per valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data. Coordinate with established valve numbering system to insure no duplication occurs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Provide permanently fastened labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

- A. Provide tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size and system served.

END OF SECTION 23 05 53

SECTION 23 05 93
TESTING ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Submittal:
 - 1. Air-Balance Report for LEED Prerequisite EQ 1: Documentation of work performed for ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- C. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Contracting Officer.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- J. Examine three-way valves for correct flow directions and installation for their intended function of diverting or mixing fluid flows.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.

- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 PROCEDURES FOR AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.

- a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from the Contracting Officer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the correct static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

3.5 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - 3. Set system controls so automatic valves are wide open to heat exchangers.
 - 4. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 5. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.6 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 2. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR CONDENSING UNITS

- A. Verify correct rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.

- B. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.10 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.

3.11 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate optimum performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.

- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.

3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Contractor's name and address.
 6. Report date.
 7. Signature of TAB supervisor who certifies the report.
 8. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 9. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 10. Nomenclature sheets for each item of equipment.
 11. Data for terminal units, including manufacturer's name, type, size, and fittings.
 12. Notes to explain why certain final data in the body of reports vary from indicated values.
 13. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Other system operating conditions that affect performance.
- D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches

- j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
3. Test Data (Indicated and Actual Values):
- a. Total air flow rate in cfm
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg .
 - e. Filter static-pressure differential in inches wg .
 - f. Preheat-coil static-pressure differential in inches wg .
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg .
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

E. Apparatus-Coil Test Reports:

1. Coil Data:
- a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Air flow rate in cfm .
 - f. Average face velocity in fpm.
 - g. Air pressure drop in inches wg.
 - h. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - i. Return-air, wet- and dry-bulb temperatures in deg F.
 - j. Entering-air, wet- and dry-bulb temperatures in deg F.
 - k. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - l. Water flow rate in gpm.
 - m. Water pressure differential in feet of head or psig.
 - n. Entering-water temperature in deg F.
 - o. Leaving-water temperature in deg F.
 - p. Refrigerant expansion valve and refrigerant types.
 - q. Refrigerant suction pressure in psig.
 - r. Refrigerant suction temperature in deg F.
 - s. Inlet steam pressure in psig.

Fan Test Reports: For supply, return, and exhaust fans, include the following:

2. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.

4. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

- F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm .
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.

 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.

- b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig .
 - h. Final total pressure in feet of head or psig .
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- G. Instrument Calibration Reports:
- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.13 INSPECTIONS

- A. Final Inspection:
- 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner's Representative.
 - 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner's Representative .
 - 3. Owner's Representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 - 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 - 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- B. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
- 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- C. Prepare test and inspection reports.

SECTION 23 07 13
DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Outdoor, exposed supply and return.
- B. Related Sections:
 - 1. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Solvent based; rated for outdoor use on below ambient services.
 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
 2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 4. Color: White.

2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 4. Color: Aluminum.

2.5 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

2.6 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, stainless-steel sheet, with beveled edge sized to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.7 CORNER ANGLES

- A. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Provide insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Provide insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Provide accessories compatible with insulation materials and environment. Provide accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Provide insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Provide multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Provide insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Provide insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Provide insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Provide insert materials and position insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Provide insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, position directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, installation shall be as follows:
1. Draw jacket material smooth and tight.
 2. Provide lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Provide jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

- C. Where PVC jackets are indicated, provide with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, provide with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, provide with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.6 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Flexible connectors.
 - 2. Vibration-control devices.
 - 3. Factory-insulated access panels and doors.

3.8 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Exposed, rectangular, supply- and return-air duct insulation shall be the following:
 - 1. Flexible Elastomeric: 2 inches, applied in two layers of one inch thick insulation.

3.9 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Provide jacket over insulation material. For insulation with factory-applied jacket, provide the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
 - 1. Stainless Steel, Type 316, Stucco Embossed: 0.016 inch (0.41 mm) thick.

END OF SECTION 23 07 13

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:

- 1. Condensate drain piping, outdoors.
- 2. Heating hot-water piping, outdoors.
- 3. Refrigerant suction and hot-gas piping, outdoors.

- B. Related Sections:

- 1. Section 23 0713, DUCT INSULATION.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

- 1. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-

applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Breather Mastic: Water based; designed for indoor and outdoor use on above-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Solids Content: 60 percent by volume and 66 percent by weight.
 - 4. Color: White.

2.4 SEALANTS

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 - 4. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

4. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.

2.5 FIELD-APPLIED JACKETS

A. Metal Jacket:

1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.6 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 3/4 inch (19 mm) wide with wing seal or closed seal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Provide insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Provide insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Provide accessories compatible with insulation materials for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Provide insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Provide multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Provide insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Provide insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Provide insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Provide insert materials and position insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Provide shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Provide insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the

- insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Provide vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Provide pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Provide mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Provide preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, fabricate cut sections of pipe and sheet insulation and adhere to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Provide insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Provide preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Provide jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Provide preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, provide mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Provide preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, provide mitered sections of pipe insulation for valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Provide insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, provide with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches (50 mm) thick.

3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Provide jacket over insulation material on exterior piping.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 - 1. Stainless Steel, Type 316, Stucco Embossed with Z-Shaped Locking Seam: 0.016 inch (0.41 mm) thick.

END OF SECTION 23 07 19

SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.5 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.6 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

1.7 SUBMITTALS

- A. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Provide measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify correct response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Contracting Officer. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Sections 23 0900, INSTRUMENTATION AND CONTROLS FOR HVAC. Assist the CxA with preparation of testing plans.
- B. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.

4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- C. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- D. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 23 08 00

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Glycol hot-water heating piping.
 - 2. Condensate-drain piping.
 - 3. Air-vent piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Glycol Hot-Water Heating Piping: 125 psig at 200 deg F (93 deg C).
 - 2. Condensate-Drain Piping: 150 deg F (66 deg C).
 - 3. Air-Vent Piping: 200 deg F (93 deg C).

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
 - 2. RTRP and RTRF with adhesive.
 - 3. Pressure-seal fittings.
 - 4. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 5. Air control devices.
 - 6. Chemical treatment.
 - 7. Hydronic specialties.
- B. Welding certificates.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.

- E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.6 EXTRA MATERIALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) .
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company.

2. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
 3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.
- E. Copper or Bronze Pressure-Seal Fittings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Stadler-Viega, or approved equal.
 2. Housing: Copper.
 3. O-Rings and Pipe Stops: EPDM.
 4. Tools: Manufacturer's special tools.
 5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).
- F. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as shown in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as shown in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as shown in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as shown in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as shown in Part 3 "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
 - c. National Fittings, Inc.
 - d. S. P. Fittings; a division of Star Pipe Products.
 - e. Victaulic Company.
 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Designed for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- G. Gasket Material: Thickness, material, and type designed for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

- B. Dielectric Unions:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.

- 2. Description:

- a. Standard: ASSE 1079.
 - b. Pressure Rating: 250 psig (1725 kPa) minimum at 180 deg F (82 deg C).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Flanges:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.

- 2. Description:

- a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig (1035 kPa) minimum at 180 deg F (82 deg C).
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elster Perfection.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
2. Description:
 - a. Standard: IAPMO PS 66
 - b. Electroplated steel nipple. complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

2.5 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig (860 kPa).
10. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig (860 kPa).
11. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Automatic Flow-Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flow Design Inc.
 - b. Griswold Controls.
 - c. Nexus Valve.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel , tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig (1207 kPa) .
9. Maximum Operating Temperature: 200 deg F (93 deg C) .

2.6 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/4 (DN 8).

6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40 -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Glycol hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be the following:
 1. Type L (B) , drawn-temper copper tubing, wrought-copper fittings, and soldered lor brazed joints.
 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- C. Air-Vent Piping:
 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.

3.2 VALVE APPLICATIONS

- A. Provide shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Provide piping as shown on the Drawings unless deviations to layout are approved on Coordination Drawings.
- B. Provide piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Provide piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Provide piping to permit valve servicing.
- E. Provide piping at indicated slopes.
- F. Provide piping free of sags and bends.
- G. Provide fittings for changes in direction and branch connections.
- H. Route piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Route groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Provide drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Slope piping at a uniform grade of 0.2 percent upward in direction of flow.
- M. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- N. Provide branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- O. Provide valves according to Section 23 0523, GENERAL-DUTY VALVES FOR HVAC PIPING.
- P. Provide unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere.
- Q. Provide flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere.

- R. Provide strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere. Provide NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
- S. Identify piping as specified in Section 23 0553, IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Section 23 0529, HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT. Comply with the following requirements for maximum spacing of supports.
- B. Provide the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Provide hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- D. Provide hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
- E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space hangers with the fewest practical rigid anchor points.
- F. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Position gasket concentrically positioned. Use applicable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Provide manual air vents at high points in piping, at heat-transfer coils, and elsewhere for system air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Provide control valves in accessible locations close to connected equipment.
- C. Provide bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Provide ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Provide blinds in flanged joints to isolate equipment.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening,

repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for correct rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.6 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 VALVES AND SPECIALTIES

- A. Check Valves:
 - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 - 3. Piston: Removable polytetrafluoroethylene seat.
 - 4. Closing Spring: Stainless steel.
 - 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 - 8. Working Pressure Rating: 500 psig (3450 kPa).
 - 9. Maximum Operating Temperature: 275 deg F (135 deg C).

2.3 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Refrigerant Piping for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Provide a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- B. Provide flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Route piping as shown unless deviations to layout are approved on Shop Drawings.
- B. Provide refrigerant piping per ASHRAE 15.
- C. Route piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Route piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Route piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Coordinate location of piping adjacent to machines to allow service and maintenance.
- G. Provide piping free of sags and bends.
- H. Provide fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 23 0900, INSTRUMENTATION AND CONTROL FOR HVAC, and Section 23 0993, SEQUENCE OF OPERATIONS FOR HVAC CONTROLS, for solenoid valve controllers, control wiring, and sequence of operation.
- K. Route piping as short and direct as possible, with a minimum number of joints, elbows, and fittings. Use long radius bends only.

- L. Arrange piping to allow inspection and service of refrigeration equipment. Provide valves and specialties in accessible locations to allow for service and inspection. Provide access doors or panels as specified in Section 08 3113, ACCESS DOORS AND FRAMES, if valves or equipment requiring maintenance is concealed behind finished surfaces.
 - M. Slope refrigerant piping as follows:
 1. Route horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Route horizontal suction lines with a uniform slope downward to compressor.
 3. Route traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
 - N. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
 - O. Locate piping with clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
 - P. Identify refrigerant piping and valves according to Section 23 0553, IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.
 - Q. Provide sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 0517, SLEEVES AND SLEEVE SEALS FOR HVAC PIPING.
 - R. Provide sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 0517, SLEEVES AND SLEEVE SEALS FOR HVAC PIPING.
 - S. Provide escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 0518, ESCUTCHEONS FOR HVAC PIPING.
- 3.4 PIPE JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
 - D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 23 0529, HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT.

B. Provide the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Provide hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain correct evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 23 84 19
POOL DEHUMIDIFICATION UNITS

Part 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install where indicated, factory-assembled, indoor swimming pool heat pump dehumidification system. System shall include compressors, evaporator coils, air side condenser reheat coil, return and supply air fans, air mixing box, air control dampers, pool water condenser, heat section, moisture disposal, complete solid state logic control system, factory-installed and wired in a single unit enclosure.
- B. The unit shall be specifically designed, manufactured and tested for enclosed swimming pool duty. Field-assembled or modified, standard, commercial grade equipment is not acceptable. Complete unit shall be suitable for indoor or outdoor, weatherproof mounting.
- C. The complete unit shall be listed by an industry recognized, third-party, safety code agency under the title of "Special Purpose Air Conditioners" and carry the appropriate label. Optional gas auxiliary heat shall be included in this listing.
- D. Manufacturer shall have a minimum of ten-plus years prior experience making similar equipment as described in this specification.

1.2 INTENT

- A. It is the intent of this section of the specifications to provide a complete, operable, adjusted natatorium dehumidification system as shown and scheduled on the plans.

1.3 BASIS OF DESIGN

- A. PoolPak International - PoolPak™ SWHP SR Model 220.

Part 2 - PRODUCT

2.1 PRINCIPLE OF OPERATION

- A. The unit shall control space temperature and relative humidity, pool water temperature and shall provide ventilation. Warm moist air from the natatorium is drawn over the evaporator coil by the return fan and latent and sensible heat is removed from the air. The heat captured by this process and the heat generated from the compressor power consumption are absorbed by a mechanical refrigeration system. The resulting dryer, cooler air is drawn is blown into a mixing box. The air from the mixing box is drawn over a reheat condenser coil and auxiliary heating coil by a supply fan.
- B. The unit shall include an automatic heating and cooling economizer control function in which the system logic determines what portion, if any, of the "leaving evaporator" air to exhaust from the mixing box and replace with an equal amount of outside air. The selected exhaust air quantity is that which will result in the least electrical consumption by the unit, based upon a comparison of outside air temperature and humidity, return air temperature and humidity and "leaving evaporator" air temperature and humidity.

- C. The refrigeration system may be activated if any of the following occur:
 1. Outside air conditions unsuitable for economizing.
 2. Space temperature drops below the set point.
 3. Space relative humidity rises above the set point.
 4. Space temperature rises above the set point.
- D. The unit shall monitor space and outside air temperature, space relative humidity, pool water temperature and building surface temperature.
- E. The thermal energy absorbed by the refrigeration system is distributed as follows:
 1. First priority is given to maintaining the natatorium space temperature. No supplementary space heating system external to the unit is required.
 2. Second priority is given to maintaining the pool water temperature.
 All heat is then transferred to a Remote Air-Cooled Condenser

2.2 UNIT CASING

- A. All panels and structural steel members shall be constructed of G-90 galvanized steel, treated and painted prior to assembly to provide a chlorine and pool chemical resistant finish. The paint shall be TGIC polyester based powder coating, applied 0.003 inch (2-3 mils) thick, baked and bonded at 420°F until it forms a hard vinyl textured surface.
- B. Structural frame shall be 3/16-inch steel channel base with 12-gauge steel cross bracing. Vertical support posts for removable panels shall be formed from 18-gauge galvanized steel and powder coat painted. All nuts, bolts and lock washers in a corrosive atmosphere shall be corrosion protected.
- C. Panels shall be formed from 18-gauge galvanized steel. Access panels shall be secured by two or more tool operated latches. All side panels shall be insulated with minimum one-inch duct liner insulation secured to panels by adhesive and panel flanges. The insulation shall be approved for 350°F operating temperature. The fire resistance rating shall conform to NFPA Standard 90A and 90B. The thermal conductivity shall not exceed 0.29 BTU/hr/F/sq. ft/in at 75 degrees F. All seams shall be bolted and sealed to prevent leaks. The roof shall be gasketed and secured to the frame with Empigard-coated galvanized steel screws.
- D. Compressors, pool water condenser and controls, including solenoid valves, expansion valves and refrigerant sight glasses shall be located in compartments isolated from unit air stream to allow for ease of maintenance and to provide protection from the corrosive atmosphere.
- E. Double-Wall Panels shall be provided for the entire unit wall and roof structure. Insulation shall be rigid bonded duct liner, 1" thick. Interior liner shall be 20-gauge G90 galvanized steel with baked epoxy powder coat finish, all sides.
- F. Hinged Access Doors shall be provided at the openings for compressor(s), air filters, electrical panel, blowers, motors, and drives. Doors shall be double-wall, insulated, mounted on stainless steel piano hinges, secured with two or more tool-operated latches and sealed against a rigid steel frame with hollow-bulb rubber gasket material. Hinged access doors are required on all outdoor installations. (Standard)

2.3 COMPRESSOR

- A. The dehumidifier shall utilize heavy-duty scroll compressors with a total of 4-stages (50, 60, 70 and 80 tons) with suction gas-cooled motors. Refrigerant shall be R-410A. Compressors shall be equipped with motor overload protection, large capacity oil sump with oil level sight glass and easily removable external crankcase heaters. Liquid refrigerant controls shall be incorporated for liquid migration protection. All components shall be located outside of airstream.
- B. Capacity control shall be microprocessor controlled by staging compressors, allowing reduced load starting and variable load operation. Capacity control through hot gas bypass is not permissible.

2.4 POOL WATER CONDENSER

- A. The internal pool water condenser shall be capable of rejecting 100% of the heat recovered from the compressor and the evaporator. Refer to the equipment schedule for required MBH capacity of the pool water condenser.
- B. Pool water condenser shall be counter-flow, tube-in-tube type. Waterside shall be Type L, cupro-nickel. For units located outdoors, the pool water condenser shall be equipped with self-regulating electric heat tape and insulation for freeze protection.
 - 2.1 Pool water condenser shall be of double-wall, vented construction with removable plugs for inspection and cleaning.
- C. Pool water heating is controlled by a refrigerant solenoid valve that directs hot refrigerant gas into the pool water condenser as a response from the control system. Water circuit shall be supplied with schedule 80 CPVC pipe stub-outs.
- D. Smart Pump Control™: The pool water condenser supply pump will be off until a call for pool water heating is received. When the unit flow switch is closed, 100% of the recovered heat is directed to the pool water condenser, heating the pool.

2.5 EVAPORATOR COIL

- A. Evaporator coil shall be of adequate face area and rows to remove the specified amount of moisture from the air stream. Refer to equipment schedule for required MBH of total evaporator coil capacity.
- B. Coil shall be Electro-Guard™ Plus corrosion resistant hydrophilic Electro coated fins. Coil shall have a flexible, epoxy polymer, E-coated in a total submersion bath, uniformly applied to all coil surface area without material bridging between fins. A spray on hydrophilic top coat shall be applied immediately after the coil emerged from the E-coat dip tank. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.5-1.5 mil on all surface areas including fin edges, end plates, structural frames, “u” bends, headers and refrigerant expansion-tube manifolds. Coating surface shall have superior hardness characteristics of 2H per ASTM D3363 and a cross-hatch adhesion of 4B-5B per ASTM B3359. Impact resistance shall be up to 100 in/lb per ASTM D2794. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D1735 and ASTM D870). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117 using scribed aluminum test coupons. The coil shall maintain hydrophilic properties without degradation of the top coat for a minimum of 1000 hours per ASTM G85 Annex 4.

1. Coil shall have a 10-year (total) extended warranty underwritten by manufacturer. (US and Canada)

- C. All tubes shall be expanded into fin collars. All joints shall be brazed. The coil shall be tested to 500 PSIG while submerged in water. All brazing shall be done with nitrogen gas inside tubes to give clean internal surfaces. The coil shall be dried and sealed. Inside of tubes shall be commercially free of oxides and foreign matter.
- D. The coil shall be sectioned to provide proportional air-to-refrigerant latent and sensible heat removal capacity. This capacity modulation shall be accomplished by utilizing multiple thermal expansion valves (TXV) for the evaporator. Each TXV shall be equipped with a refrigerant flow control solenoid valve and refrigerant sight glass.

2.6 CONDENSER COIL (AIR REHEAT COIL)

- A. Condenser coil shall be capable of rejecting all heat (100%) recovered from the compressor and evaporator. Refer to equipment schedule for required MBH of reheat coil capacity.
- B. Coil shall be Electro-Guard™ corrosion resistance Electro coated fins. Coil shall have a flexible, epoxy polymer, E-coated in a total submersion bath, uniformly applied to all coil surface area without material bridging between fins. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.5-1.5 mil on all surface areas including fin edges, end plates, structural frames, “u” bends and headers. Coating surface shall have superior hardness characteristics of 2H per ASTM D3363 and across-hatch adhesion of 4B-5B per ASTM B3359. Impact resistance shall be up to 100 in/lb per ASTM D2794. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D1735 and ASTM D870). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117 using scribed aluminum test coupons.
 - 1 Coil shall have a 10-year (total) extended warranty underwritten by manufacturer. (US and Canada)
- C. All tubes shall be expanded into fin collars. All joints shall be brazed. The coil shall be tested to 600 PSIG while submerged in water. All brazing shall be done with nitrogen gas inside tubes to give clean internal surfaces. The coil shall be dried and sealed. Inside of tubes shall be commercially free of oxides and foreign matter.

2.7 HOT WATER COIL

- A. Coil shall be Electro-Guard™ corrosion resistance Electro coated fins. Coil shall have a flexible, epoxy polymer, E-coated in a total submersion bath, uniformly applied to all coil surface area without material bridging between fins. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.5-1.5 mil on all surface areas including fin edges, end plates, structural frames, “u” bends and headers. Coating surface shall have superior hardness characteristics of 2H per ASTM D3363 and across-hatch adhesion of 4B-5B per ASTM B3359. Impact resistance shall be up to 100 in/lb per ASTM D2794. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D1735 and ASTM D870). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117 using scribed aluminum test coupons.

1. Coil shall have a 10-year (total) extended warranty underwritten by manufacturer. (US and Canada)
 - B. All tubes shall be expanded into fin collars. All joints shall be brazed. The coil shall be tested to 320 PSIG while submerged in water. The coil shall be dried and sealed. Inside of tubes shall be commercially free of oxides and foreign matter. Coil assembly shall have 1600 PSIG ultimate strength.
 - C. Hot water flowing through or bypassing this coil shall be controlled by a factory installed three-way control valve. This valve shall be controlled by the PoolPak™ control system. The valve actuator shall have NEMA 2 housing with GoreTex vents and auto open on power failure.
- 2.8 RETURN AND OUTSIDE AIR FILTERS
- A. The evaporator and reheat condenser coil shall each be protected with a separate upstream air filter system. The filters shall be laminated polyester construction, replaceable type. The filters shall have a non-migrating tackifier encapsulated between the second and third laminates. They shall be totally non-toxic, non-allergenic and will not support the growth of bacteria and fungus.
 - B. The filter shall be 2 inch thick, MERV 8 rated.
- 2.9 OCCUPIED/UNOCCUPIED OUTSIDE AIR AND EVAPORATOR BYPASS DAMPERS AND MOTORS
- A. During the occupied cycle the motorized outside air damper shall be driven open and the evaporator air, motorized bypass damper shall be driven closed. A dry contact closure will activate a field-supplied exhaust fan. During the unoccupied cycle this sequence shall be reversed.
 - B. Dampers motors shall be weather proof with GoreTex vents and auto close-on-power failure.
- 2.10 MIXING BOX
- A. The mixing box shall be integral to the unit and physically located between the evaporator and reheat condenser coils. The mixing box shall be equipped with three dampers to control the amount of exhaust, outside and re-circulated air. The exhaust damper shall be downstream of the evaporator coil to allow full heat reclaim prior to the being exhausted. The reheat condenser coil shall be located downstream of the outside air intake to allow utilization of outside air when available or necessary. The damper motors shall have NEMA 2 housing with GoreTex vents and auto close on power failure and shall use a brushless DC motor.
- 2.11 DAMPERS
- A. Dampers shall be parallel blade, less than 1% leakage, neoprene tipped, anodized-aluminum air foil cross-section dampers. Each damper section shall be operated by a separate motor, factory mounted and wired into the unit control panel and be capable of modulating the dampers from 0-100%
- 2.12 FANS (BLOWERS)
- A. Unit shall be factory equipped with all required fans. The fans shall be sized per the airflow and external static pressure resulting in the horsepower shown on the

equipment schedule. Fans shall be balanced to ensure room negative pressure in the natatorium per the scheduled conditions. These fans shall be multi-V-belt driven, double-inlet centrifugal-type with multi-blade wheels. Construction shall be galvanized steel, painted and baked with an epoxy coating providing a chlorine and pool chemistry resistant finish. The fans shall be dynamically and statically balanced and tested on the shafts. Fan bearings shall be grease-lubricated, self-aligning ball bearings selected for 200,000 hours average life.

- B. Fan shall be multi-V-belt driven, double-inlet centrifugal-type with multi-blade wheels. The blower scroll and housing shall be constructed of cold-rolled steel, coated with an electrostatically applied TGIC polyester paint on G90 galvanized steel. The wheel shall be dynamically and statically balanced and tested on the steel shafts. The fan bearings shall be grease lubricated, self-aligning ball bearings selected for 200,000 hours average life.

2.13 FAN (BLOWER) MOTORS

- A. Fan motor shall be NEMA premium efficiency, totally enclosed, fan-cooled TEFC, with Class F insulation, pre-lubricated ball bearings and mounted on an adjustable base. Motor efficiency shall comply with EPACT-92 requirements as a minimum. Motor to be U.L. listed. Fan motor shall be provided with a factory-mounted and wired motor/starter protector with an adjustable thermal overload and magnetic short circuit protection. The use of Open Drip-Proof (ODP) motors **is not acceptable**.

2.14 SUPPLY AIR FAN

- A. Unit shall be equipped with an integral supply-air system. A supply-air fan capable of providing the specified amount of air shall be located in the unit as required. The fan shall operate continuously.
- B. Fans shall be a forward-curved (FC) dual-inlet (Standard) design.
- C. No fan isolation (Standard) shall be provided.

2.15 RETURN AIR FAN

- A. Unit shall be equipped with an integral return/exhaust air system. A return air fan capable of exhausting the specified amount of air shall be located in the return air plenum. This return fan will operate whenever the dehumidifier's supply fan is activated.
- B. Fans shall be a forward-curved (FC) dual-inlet (Standard) design.
- C. No fan isolation (Standard) shall be provided.

2.16 DRAIN PAN

- A. The floor of each airside section shall be constructed of galvanized steel and powder-coat painted with a protective coating providing a chlorine and pool chemistry resistant finish. The floor sections shall be fully insulated with closed cell foam. The floor sections under condensate producing coils shall be sloped toward the drains and piped to a common drain accessible from either side of the unit. All drain lines within the unit shall be insulated with a minimum 1/2 inch closed-cell foam with self-regulating electric heat tape for freeze protection.

2.16 REFRIGERATION CIRCUIT

- A. The refrigeration system shall include a replaceable core liquid line filter dryer, liquid receiver, thermostatic expansion valves, liquid line solenoid valves, two manual valves to isolate filter drier for fast drier core replacement and manual valves to isolate the liquid receiver. Suction lines shall be fully insulated with closed-cell foam insulation. High and low pressure controls and refrigeration service access valves shall be located in a compartment outside of the air stream.

2.18 ELECTRICAL CONNECTIONS

- A. Power Connection: The unit shall be equipped with two factory-mounted motor starter connections, one for the fan and control transformer circuit and one for the compressor circuit. The terminal blocks shall be suitable for copper conductors only. Electric heat and remote or “piggy-backed” ACC requires separate power feed.

2.19 CONVENIENCE OUTLET

- A. A grounded, 120 VAC, 8 amp max., GFCI-protected, duplex convenience outlet shall be provided in the compressor compartment.

2.20 COMPARTMENT LIGHTS

- A. GFCI protected, NEMA 4 switch and guarded lights shall be provided inside the dehumidifier for service and maintenance convenience.

2.21 FILTER STATUS INDICATOR

- A. Unit shall be equipped with sensors to detect when the pressure drop through the return air filters indicates the filters are dirty. When the pressure drop is greater than the preset limit (user programmable), a display on the controller panel will indicate percent filter life remaining.

2.22 RAIN HOODS and LOUVERS (For Outdoor Units Only)

- A. Unit shall be equipped with a rain hood or louver and bird screen for both the outside air and exhaust air dampers.
- B. Rain hood shall be constructed so as not to reduce the face area of the dampers. Rain hood, bird screen construction and paint shall be the same as the dehumidifier casing. The rain hood and bird screen shall be shipped loose with the unit for field installation by installing contractor.

2.23 OPERATING AND SAFETY CONTROLS

- A. Each unit shall be provided with a complete operating and safety logic control system. The control system shall shut down the compressor in cases of high refrigerant pressure, low refrigerant pressure, and high motor temperature conditions. The complete unit (fans & compressors) shall be shut down to protect the motors if power line abnormalities occur.
- B. Operating and safety control system shall include all relays, motor controllers, sensors and switches necessary to operate complete unit.

2.24 MICROPROCESSOR CONTROLLER

- A. Controller shall be microprocessor based and functions/set points shall be programmable at the panel as follows:
 - I. Space Dry Bulb Temperature
 - II. Space Relative Humidity
 - III. Pool Water Temperature
 - IV. Occupied/Unoccupied Schedule
 - V. Damper Positions
- B. The following readouts and annunciation lights shall be provided on the unit-mounted or remote-mounted, 4-line, 20-character, backlit LCD display:
 - I. Power On
 - II. Space Dry Bulb Temperature
 - III. Pool Water Temperature
 - IV. Pool Water Flow
 - V. Wall Condensation Prevention Temperature
 - VI. Outside Air Filter Air Pressure Drop
 - VII. Outside Air Dry Bulb Temperature
 - VIII. Outside Air Relative Humidity
 - IX. Supply Air Dry Bulb Temperature
 - X. Damper Position
 - XI. Compressor Circuit Fault
 - XII. Compressors Off
 - XIII. First Stage of Compressor On
 - XIV. Second Stage of Compressor On (if so equipped)
 - XV. Third Stage of Compressor On (if so equipped)
 - XVI. Fourth stage of Compressor On (if so equipped)
 - XVII. Compressor Suction Pressure
 - XVIII. Compressor Discharge Pressure
 - XIX. Compressor Suction Temperature and Liquid Temperature
 - XX. Unit in Air Heating Mode
 - XXI. Unit in Dehumidifying Mode
 - XXII. Auxiliary Air Heating Coil On
 - XXIII. Pool Water Heating On
 - XXIV. Time of Day / Date / Day of Week
 - XXV. Supply Fan Current
 - XXVI. Return Fan Current
 - XXVII. Compressor Current

- 2.25 Control panel shall be integral to the unit and located in a separate compartment isolated from airflow. Dry contacts shall be provided for alarm

and fan interlock. Power block terminals shall be provided for different wire size connections. All wires shall be numbered or color-coded for ease of trouble-shooting. The compressor(s) shall be equipped with motor starter protectors for dual-point power and have an anti-recycle timer to prevent short-cycling. The blower motors shall be equipped with motor starter protectors, including adjustable thermal overloads and magnetic short circuit protection.

- 2.26 The memory of the microprocessor control panel shall have a fault code history log. This fault code history log shall record the last 50 fault codes in the order of their occurrence. Each fault code shall be recorded along with the date and time it occurred and the value of the critical system parameters at the time of the fault. This fault code history log shall be accessible at the unit controller display and at the standard Remote Interface Unit (RIU).
- 2.27 The microprocessor control panel shall be capable of monitoring and logging the status of the Microprocessor Controller functions, readouts and setpoints for 72 hours. This data will reside in the controller's non-volatile memory, and can be downloaded via a removable USB flash drive.
- 2.28 The controls shall continuously monitor the 3-phase power lines for abnormal conditions such as high voltage, low voltage, phase unbalance, phase reversal, and phase loss, even when regenerated voltage is present. The device consists of a solid-state voltage and phase-angle sensing circuit driving an electro-mechanical relay. A fault condition shall de-energize the relay; when the fault is corrected the device shall automatically reset. Fault conditions are logged and can be read from the display on the phase monitor.

2.29 CONTROL SENSORS

- A. The unit shall be provided with the following factory-mounted and wired control sensors:
 - I. Space Dry Bulb Temperature
 - II. Space Relative Humidity
 - III. Air-Leaving-Evaporator Dry Bulb Temperature
 - IV. Air-Leaving-Evaporator Relative Humidity
 - V. Pool Water Temperature
 - VI. Supply Air Dry Bulb Temperature (Except with furnace larger than 800 MBH)
 - VII. Compressor Motor Current
 - VIII. Supply Fan Motor Current
 - IX. Return Air Filter Pressure Drop
 - X. Outside Air Filter Pressure Drop
 - XI. Return Fan Motor Current
- B. The unit shall be delivered with the following factory-supplied sensors to be installed in the field:
 - I. Outside Air Dry Bulb Temperature
 - II. Outside Air Relative Humidity
 - III. Wall Condensation Prevention Temperature Sensor

- IV. Pool Water Temperature Sensor for Smart Pump Option
- V. Supply Air Dry Bulb Temperature (With furnace larger than 800 MBH)

2.30 SEQUENCE OF OPERATION

- A. All operating and logic controls shall be factory-mounted and wired in the unit. Control sequences shall be designed specifically to control swimming pool environmental conditions.
- B. Control system shall provide modulation of heat recovery/heating system by proportional control of dry bulb temperature, relative humidity, cold-wall surface condensation prevention humidity reset and ventilation air volume.
- C. Controls shall automatically operate heating, dehumidification and heat recovery system in response to greatest requirement and adjust unit outputs to maintain building conditions. Unit and controls shall be capable of providing full heating capacity to either air or water. Controls shall be capable of proportional control of heating and dehumidification by loading stages of compressor capacity as necessary. As building requirements are satisfied, unit shall unload and shut off compressors.

2.31 Unit shall provide the following functions:

- A. **Ventilation Mode:** Provide outdoor ventilation air to satisfy minimum ventilation air requirements per ASHRAE 62-04 Ventilation Code.
- B. **Heating, Cooling and Dehumidification Economizer Mode:** Provide outdoor air as a function of indoor and outdoor conditions. The economizer shall operate in the space heating, space cooling, space heating/dehumidification or space cooling/dehumidification modes.
- C. **Exhaust Mode:** Each unit shall have an exhaust mode to partially ventilate the natatorium at a specified airflow. The exhaust mode shall be programmed by the owner as needed. Unit controls shall control the supply and exhaust air fan systems and open the outdoor air and exhaust air dampers for a programmed time interval for automatic operation. The use of an exhaust fan in lieu of a full sized return fan system is not acceptable.
- D. **Purge Cycle:** Each unit shall have a purge cycle to fully ventilate the natatorium at 100% airflow specified for the supply fan. The exhaust/purge cycle shall be programmable by the owner as needed to ventilate the natatorium after shocking of the pool has been performed. Unit controls shall control the purge air fan systems and open the outdoor air and exhaust air dampers for a programmed time interval for automatic operation. During purge mode, the compressors are deactivated.
- E. **Event Mode Schedule:** The Event Mode changes the ventilation air quantity to meet the demands of an event or situation where additional outside air is needed. The unit controller can store up to 28 schedule events, which shall be user adjustable at the Remote User

Interface (RUI). During Event Mode, the minimum damper position is raised to a value higher than the minimum damper set point. For each event, the screen shall show the day of the week, the hour in 24-hour format, the minute and the event type.

- F. **Occupied/Unoccupied Control Mode:** Microprocessor-based, 7-day, 24-hour operation controls manage the occupied/unoccupied mode operation during heating season. During unoccupied times the outside air dampers shall be closed to minimize the air-heating load.
- G. **Space Heating:** Full proportional control of space dry bulb temperature shall be maintained by staging compressor loading of unit capacity, with humidity override. Automatic mechanical heat recovery from pool room return air as required by building and water temperatures. Return/exhaust air must pass through the mechanical heat recovery system and shall be exhausted at the lowest heat content. Automatic switching and proportioning outputs for control of auxiliary air heating shall be performed.
- H. **Smart Economizer:** The Smart Economizer is the simultaneous operation of the Heat Recovery heating and Economizer modes. When the natatorium requires dehumidification or heating and the outside air dry bulb and dew point are warmer/drier than the air off the evaporator coil, then 100% warm, dry air is drawn into the PoolPak™ with the supply fan. The warm, dry outside air is heated further as it passes over the condenser coil and is supplied to the natatorium.
- I. **Pool Water Heating:** If the space temperature is at or above set point and the pool water temperature is below the set point; hot gas is directed to the pool water condenser when the compressor is running. At times when the pool water requires heat, the PoolPak™ activates the main pool water heater. See schedule for amount of heat rejection provided by the pool water condenser.
- J. **Smart Pump Control™ for Pool Water Heating:** The pump circulating water to the pool water condenser shall be deactivated by a signal from the dehumidifier control panel when the pool water condenser is not being used to heat pool water. This option requires the pool water temperature sensor to be shipped loose and field installed (by others) in a location where it can sense pool water temperature under all conditions.
- K. **Humidity Control:**
 - 1. The economizer is activated if dehumidification is required and all of the following occur:
 - 1.1 Air and water temperatures are satisfied.
 - 1.2 Absolute humidity of the outside air is lower than the absolute humidity of the poolroom air.
 - 1.3 Outside air temperature will not adversely affect the pool room air temperature.
 - 2. When outside air cannot be used for dehumidification, full proportional control of humidity is done by staging unit

capacity. The humidity controller energizes the compressor and directs hot gas to the air reheat condenser if the space requires heating or the pool water condenser if pool water temperature is below set point.

3. If dehumidification is required and the air/water temperatures are satisfied, then the hot gas is directed to the air-cooled .

L. Space Cooling:

DX Cooling with Remote Air-Cooled Condenser: On a call for space cooling, the refrigeration system is energized. The return air passing through the unit's evaporator coil is cooled. The cooled air is delivered to the natatorium by the supply fan. The heat recovered by the evaporator and compressor is directed to the remote air cooled condenser.

M. **Condensation Prevention - Cold-Wall Temperature Sensor**

Humidity Reset Control: When the temperature of the interior surface at the wall sensor drops to within 5°F of the dew point temperature of the space air, the relative humidity set point is offset downward. This condition causes the dehumidifier system to activate humidity control to lower the space dew point and hinder the formation of condensation on the cold wall or glass surfaces.

2.32 BACnet/IP (Optional)

- A. The dehumidifier control panel shall be capable of direct connection to a BACnet/IP-based Building Automation System. With proper connection to the Ethernet network, the dehumidifier shall appear as a native BACnet device.

2.33 VIRTUAL-TECH™: REMOTE ACCESS PACKAGE (RAP), WEB-based INTERFACE

- A. The dehumidifier shall be remotely monitored and controlled. All setpoints and monitoring functions listed in the MICROPROCESSOR CONTROLLER paragraph shall be capable of being remotely controlled and monitored from the remote terminal and simultaneously at the dehumidifier control panel. Remote monitoring and control shall be accomplished with a microprocessor-based web server (by PoolPak International) located in the dehumidifier unit control panel. The dehumidifier shall be monitored and controlled from any workstation on the network using standard web browser software.
- B. Data Logging shall be accomplished via the self-contained microprocessor/file storage capability of the above RAP hardware. The web server shall be capable of storing data in a historical or circular data log.
- C. Hardware and software capable of automatically notifying an authorized service organization of a PoolPak™ unit monitored malfunction shall be provided by the unit manufacturer.
- D. A connection to a (10BaseT) Ethernet network with Internet access shall be owner furnished.

2.44 REMOTE AIR-COOLED CONDENSER (ACC)

- A. Each dehumidifier shall be equipped with a remote air-cooled condenser. All interconnecting refrigerant piping shall be the responsibility the installing contractor and shall be in accordance with manufacturer's recommendations.
- B. Unit cabinet is constructed of galvanized sheet metal. All panels are removable. Condenser coils are copper tube with bare aluminum fins, galvanized steel frames and tube sheets. Condenser fans are staged in response to head pressure down to 20°F. Fused fan motor contactors are mounted inside the unit.

Part 3 – EXECUTION

3.1 FUNCTIONAL FACTORY TEST AND VERIFICATION

- A. The completed unit shall be completely tested for functionality in the factory before shipment.
- B. The functional test shall consist of an in-unit test of the controller, inputs, outputs, safeties and the basic sequence of operation. Also, part of the functional test will be verification of the operation of compressor(s), fan(s), associated electrical components and, if furnished, gas furnace controls and the valve actuators for coils. The functional test shall not be construed as a performance or capacity test.
- C. Each unit will have a record of the test documented with the unit serial number. Field testing of components or the sequence of operation is not a substitute for factory testing.
- D. A copy of the functional test report shall be maintained on file at the factory and can be furnished upon request.

3.2 INSTALLATION

- A. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified and where manufacturer's technical representative directs otherwise.
- B. Install unit where shown on drawings. Provide 3-foot clearance around sides and 4-foot around compressor compartment of unit for airflow and service. Provide a means for access to all sides of the unit.

3.3 START-UP, OWNER TRAINING & WARRANTY

- A. All units shall be thoroughly cleaned by the installing contractor in accordance with the manufacturer's instructions, prior to being placed into service.
- B. Start-up service shall be provided by the equipment manufacturer's authorized representative and shall include complete testing of all controls and unit operation. The agency responsible for start-up shall record the refrigeration system pressures and electrical operating data. Copies of this data are to be supplied to the owner. US – Standard
- C. A complete operating and maintenance manual, including wiring diagrams, start-up and operating sequence and material list shall be provided to the owner. The owner shall be provided with complete instruction of operating and maintenance procedures.

- D. Manufacturer shall provide owner with on site training by factory-trained service personnel. Training shall cover the operation and maintenance requirements of this unit. This training session shall be held at time of factory start up.
- E. Manufacturer shall provide to the owner a web-based, instructional video program for use by field personnel.
- F. Manufacturer shall provide a one year labor and 25-month parts warranty on the entire unit. (US and Canada)
- G. Manufacturer shall provide a 3-5 year extended compressor part warranty. (US and Canada)

End of SECTION 23 84 19

DIVISION 26 – ELECTRICAL

SECTION 26 05 19 LOW-VOLTAGE CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building wire; and wiring connectors and connections.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 14 AWG for control circuits.
 - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods unless specifically noted otherwise on the Contract Drawings:
 - 1. Exposed Dry Interior Locations: Use building wire, Type THHN/THWN insulation, in raceway.
 - 2. Exterior Locations: Use building wire, Type THHN/THWN insulation, in raceway.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for overall submittal procedures and specific requirements associated with each type of submittal listed below.
- B. Types of submittals required for this Section:
 - 1. Product Data

- C. Refer to the List of Submittals document at the end of Division I for a detailed list of every submittal required for the products and workmanship covered under this Section.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 PRODUCTS

2.1 BUILDING WIRE

- A. Product Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic or Thermosetting, as indicated above.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify mechanical work likely to damage wire and cable has been completed.
- B. Verify raceway installation is complete and supported.

3.2 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned.

3.3 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.4 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Extend existing circuits using materials and methods as specified.
- D. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.5 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Color Code wire and cable as stated herein.
- D. Equipment Grounding Conductor: Install separate, insulated copper conductor with each feeder and branch circuit. Terminate each end on suitable lug, bus, or bushing.
- E. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- F. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- G. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- H. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.6 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 26 28 19 ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes enclosed fusible switches.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for overall submittal procedures and specific requirements associated with each type of submittal listed below.
- B. Types of submittals required for this Section:
 - 1. Product Data
 - 2. Shop Drawings
- C. Refer to the List of Submittals document at the end of Division I for a detailed list of every submittal required for the products and workmanship covered under this Section.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 PRODUCTS

2.1 FUSIBLE DISCONNECT SWITCH

- A. Product Description: NEMA KS 1, Type Heavy Duty, fused, 100 Amp, 600 VAC, enclosed load interrupter knife switch. Handle lockable in OFF position. Handle interlocked to prevent accidentally opening front cover with switch in ON position. Provide means to bypass handle interlock.

- B. Fuse: Type J, dual element, time delay, current limiting. Fuse Size indicated on Contract Drawings.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class J fuses.
- D. Horsepower Rating: As indicated on Contract Drawings and/or required by manufacturer of equipment being controlled.
- E. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
- F. Outdoor Enclosure: NEMA KS 1, Type 3R, galvanized steel.
 - 1. Door: Hinged with padlock provisions.
 - 2. Color: Factory painted gray enamel.
- G. Furnish switches with entirely copper current carrying parts.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned enclosed switches.
- B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean existing enclosed switches to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosed switches plumb.
- B. Location:
 - 1. Mount disconnect switches to existing railing.
- C. Height:
 - 1. 5 feet maximum to operating handle.
- D. Install fuses for fusible disconnect switches.

3.3 FIELD QUALITY CONTROL

- A. Field test all switches for proper on/off operation

END OF SECTION