SECTION 23 00 00 – MECHANICAL SYSTEMS SPECIFICATIONS INDEX

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 INTENT/SCOPE

A. It is the intent of this specification and accompanying drawings to describe and indicate the manufacture, erection and installation of the equipment and connection to the same specified herein and shown on the drawings. It is not intended that the specifications and drawings describe and indicate each piece of equipment required for installation, for where items are intended or required for a satisfactory installation and are the accepted practice of the trade, they shall be considered to be both specified and indicated.

B. This Specification and the Contract Drawings are intended to be utilized by the HVAC Contractor to install certain heating, ventilating and air conditioning equipment, but are not to be interpreted to contain certain basic system installation knowledge essential for a complete and quality installation. By providing a bid to the Owner, this HVAC Contractor is certifying that he/she has experience in installations of HVAC systems of comparable size and possesses knowledge and employs knowledgeable personnel to ensure the HVAC installation is complete in all respects.

C. The terms "The Contractor", "This Contractor", “HVAC Contractor” or "Heating Contractor" mentioned in these Specifications refers to the HVAC Contractor responsible for the installation in its entirety.

D. Due to the small scale of the drawings, all required offsets and fittings may not be shown but shall be provided at no change in the contract price.

E. As many of the lines as could practically be shown on the drawings have been identified, but some have been omitted for clarity. The Contractor shall furnish and install all such piping that may be required or directed to effect proper connections to all apparatus, equipment, and fixtures in accordance with the manufacturer’s detailed drawings and instructions.

F. The Contractor shall schedule and coordinate all work in close cooperation with all trades working on this project.

G. Work and materials are to be installed subject to the approval of the Engineer and the Owner.

H. Where the word "Engineer" appears in this Specification, it means Engineer and Owner. References to "Architect" are to mean "Owner" or "Engineer".

I. The Contractor is to carefully examine the site, Plans and Specifications and include labor and equipment necessary to perform, but not necessarily limited to, the following work:

1. Demolish and remove the existing chillers, associated condenser and chilled water pumps and all associated piping, hangers, accessories and controls associated with such items.

2. Demolish and remove the existing Electric Water Heater and prepare piping for direct replacement.

3. Furnish and Install two (2) new modular style chillers including all accessories and controls.

4. Furnish and Install a new chilled water and condenser water pump for each new chiller including new VFD

5. Furnish and Install all new controls for each system, tied into the existing campus Johnson Controls Automatic Temperature Control System.

6. Furnish and Install a new refrigerant detection system including new monitor panel and refrigerant detectors in compliance with ASHRAE Standard 15. The new system is to interlock with the existing Exhaust fan which will remain and be reused.

7. All other miscellaneous work shown on the Drawings and as herein specified.

J. The requirements of this Section apply to all sections of Division 23.

K. IMPORTANT - all work specified here in is to be included in the base bid for the project. Provide a deduct alternate bid to remove the furnishing and installation of Chiller (CH-2) and associated Pumps (P-2 & P-4). Refer to the drawings for more information.

1.2 RELATED REQUIREMENTS/SECTIONS

A. The specifications sections "General Conditions", "Special Conditions" and "General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. Section 013000 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.

1.3 REFERENCE STANDARDS/APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced.

B. The publications are referenced in the text by the basic designation only. The most recently adopted version of the reference publication shall govern.

C. Where conflicts occur the more stringent version will apply.

1. NFPA National Fire Protection Association

2. UL Underwriters' Laboratories, Inc.

3. NEMA National Electrical Manufacturer's Association

4. NEC National Electric Code - NFPA 70

5. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers

6. ARI American Refrigeration Institute

7. ASME American Society of Mechanical Engineers
8. AWS American Welding Society
9. ANSI American National Standards Institute
10. HI Hydronics Institute
11. OSHA Occupational Safety and Health Act
12. ASTM American Society for Testing and Materials
13. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc.:
14. International Building Code
15. International Mechanical Code
16. International Energy Conservation Code
17. Requirements of the authority having jurisdiction, including but not limited to, amendments to the International Codes.
18. Requirements of the equipment manufacturers.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination Drawings:

1. Coordination Drawings are required for all projects regardless of scope or size.
2. No installation of permanent systems shall be performed without prior review and approval of the coordination drawings by the Design Professional.
3. Coordination Drawings are to be provided in AutoCAD format and at a scale not smaller than 1/4" per foot and on paper size not smaller than Arch D (24"x36").
4. Coordination Drawings may be omitted upon the contractor having throughly inspected the construction site and providing assurance in writing that coordination of the trades will not be an issue.
5. Proceeding with work without approved coordination drawings illustrates acceptance of item 4 above and the contractor proceeds at their own risk. Conflicts due to lack of coordination will require the interpretation of the Engineer prior to proceeding with Construction and any rework or remediation will be required based on the Engineer's interpretation without the commitment of added expense to the Owner.
6. When work is installed without proper coordination, changes to this work deemed necessary by the Engineer shall be made to correct the conditions without extra cost to the Owner.

B. Pre-Construction Meeting: Conduct a Pre-Construction Meeting prior to the start of the work of this section; require attendance by all affected installers. Refer to the General Conditions for additional information.

1.5 SUBMITTALS

A. General: Provide submittals in accordance with the General Conditions of the Contract and this Section.

1. Approval: Is to be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

2. All materials, appliances, machines and fixtures are to satisfy completely all the specification requirements in each case and are to be of the best available quality and grade. Equipment of equal quality with a satisfactory record of performance will b considered for review.

3. Mark submittals with applicable Project Name, Specification Section # (and paragraph if applicable) and Drawing reference/tag. Submissions are to be coordinated with the contract Drawings and be marked and clearly labeled using tag descriptions as indicated there on. Where multiple models are indicated on the submission, the submission is to be marked up by the Contractor to indicate which model is being proposed. Unmarked, unlabeled submissions will be rejected.

4. The submittals are to be complete with necessary construction and functional details requisite for a thorough evaluation. Such items as are rejected are to be promptly resubmitted in conformity with the Specification requirements. Corrections or comments made on Shop Drawings during this review will not relieve the Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the information given in the Contract Documents. The Contractor is to be responsible for: confirming and correlating quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of other trades and performing his work in a safe and satisfactory manner.

5. Submittals for individual systems and equipment assemblies, which consist of more than one item or components are to be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

6. Electronic submissions will be accepted if the submission contain less than 10 printed pages. If the submission is larger than 10 pages, one hard copy is to be sent directly to the Engineer in addition to the standard electronic delivery.

7. Deliver electronic submissions to the Owner who will forward them to Rebecca Berkey - RebeccaB@easthillseng.com and all hard copy submissions to East Hills Engineering Associates LLC, 541 Main Street, Windber, PA 15963.

8. Product Data: After award of the Contract submit:

a. A complete list of all materials proposed to be furnished and installed under this Section. At a bare minimum the contractor is required to submit on the following prior to installation:

   1) Chillers

   2) Automatic Temperature Controls

   3) Copies of Warranty Cards

   4) Letter of Certification that Instructions Have Been Given

   5) Operation and Maintenance Manuals

   6) Piping and Pipe insulation

   7) Piping Specialties (thermometer, pressure gages, flow monitors, flow switches, etc.)

   8) Pumps

   9) Refrigerant Moniror

   10) Variable Frequency Drives

   11) Water Balance Report

b. Information, which confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.

c. Manufacturers' recommended installation procedures which, when approved by the Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used on the Work.

d. Product Identification. Submittals for mechanical equipment, shall be identified by the fixture tag that is indicated on the drawings. Where a submittal includes information on multiple unit sizes, etc. the proper unit is to be marked on the submitted form.

e. Submittals on all mechanical equipment (i.e. chillers, pumps, etc.), complete with capacities, performance curves marked with design points and all applicable engineering data.

f. Submittals on electrical equipment for mechanical equipment, complete with all power and control wiring diagrams.

g. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

B. Closeout Submittals:

1. Operation and Maintenance Data: Provide Operation and Maintenance Data in accordance with the General Conditions of the Contract and per Part 3 of this Section – Operations and Maintenance Manuals.

2. Warranties and Bonds: Provide Warranties and Bonds in accordance with the General Conditions of the Contract and per Part 3 of this Section – Warranties and Bonds.

3. As-Built Drawings: Provide Record Documentation (As-Built Drawings) in accordance with the General Conditions of the Contract and this section.

    a. Record Drawings During Construction: During progress of the Work, maintain a current (daily) record set of Contract Drawings and Specifications, indicating thereon work installed at variance with such Contract Documents, including work covered by supplemental contracts, addenda, change orders or other bona fide sources. All variances to the Original Contract Documents are to be indicated in red.

    b. Close out Documents: At the completion of the construction work and as a condition of its acceptance, furnish to the Architect these marked-up documents to be used by the Owner as a record of exact locations of installed systems. The marked-up Drawings may be utilized by the Architect to prepare "As-Constructed" AutoCAD Drawings.

C. Substitutions:

1. The various materials and products specified in the Specifications by name or description are given to establish a standard of quality and of cost for bid purposes. It is not the intent to limit the acceptance to any one material or product specified but rather to name or describe a material or product as the absolute minimum standard that is desired and acceptable. A material or product of the lesser quality would not be acceptable.

2. IMPORTANT: Where a product is named by manufacturer and model number and other manufacturer's names are listed (in parentheses), those names in parentheses are considered to be substitute manufacturers whose equipment may be acceptable, provided that they meet the intent of the Specification, and meet or exceed required capacities.

3. Where only one name is stated in this Specification, only that manufacturer's equipment will be acceptable.

4. Equipment is to be installed in accordance with the manufacturer's data and recommendations.

5. Where equipment is not specified, it is intended that only first grade material be used. Only new equipment in good condition will be accepted. Equipment is subject to inspection and approval of the Engineer.

6. Items installed prior to approval by the Engineer are at the Contractor's risk. The Engineer may require non-approved items to be removed and replaced with specified items.

7. **EXTREMELY IMPORTANT:** Resubmission of items rejected or marked "Revise and Resubmit" will be reviewed one time by the Engineer at no cost to the Contractor. Should the resubmittal be rejected or marked "Revise and Resubmit", the Contractor will be invoiced for any additional time spent by the Engineer at his current billing rate.

8. The Contractor is to assume sole responsibility for structural, mechanical, and electrical changes required to accommodate substituted material or equipment.

9. Should it be shown by printed data that any substituted piece of equipment uses more energy (natural gas, electricity, etc.) than the piece of equipment upon which design was based, the substituted piece of equipment will be rejected.

1.6 QUALITY ASSURANCE

A. It is the intention of these documents to conform to all applicable codes, standards, regulations and guidelines as referenced. In the event that a discrepancy between the documents and governing documents occurs the Contractor is to immediatly inform that Architect to obtain an interpretation and proper instructions.

B. All equipment is to meet or exceed the requirements of the Energy Efficiency Code being enforced by the Authority Having Jurisdiction.

C. Manufacturer Qualifications are indicated under the specific sections within this Division pertaining to the equipment they are to provide.

D. Contractor Qualifications: By submitting a bid to the General Contractor or Owner, this Contractor attests that they employ personnel with experience installing systems of similar size and scope and can provide references for at least three (3) similarly sized projects completed within the last five (5) years.

E. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receipt of Equipment and Material

1. New equipment being used on this project, whether delivered to jobsite or to this Contractor's place of business, is to be examined (to determine if the equipment was damaged) prior to signature of receipt by the Contractor's representative. It is the Contractor's responsibility to file damage claims with the mover (truck, railroad, etc.) at time of receipt of damaged equipment.

B. Protection of Equipment

1. It is to be the responsibility of the Contractor to protect equipment, piping, insulation, controls and similar items of equipment from dirt, grime, plaster and water during each phase of

construction. This protection is to be provided by covering with transparent plastic sheeting, caps or as required to the satisfaction of the Engineer.

2. Protection is to include sheds or other buildings as required for protection of materials and equipment. In the event the available areas on the site are inadequate, the Contractor is to, at his own expense, provide suitable storage under roof at other locations.

C. Storage of Material

1. The Contractor is to erect and maintain proper facilities for protecting materials and equipment furnished under this Contractor during each phase of construction until acceptance by the Engineer. Any damaged materials or equipment is to be repaired or replaced by the Contractor at his own expense to the satisfaction of the Engineer and the Owner.

1.8 COMPLIANCE WITH CODES, LAWS, REGULATIONS AND STANDARDS

A. Bidders must have determined applicability, became thoroughly familiar and are required as part of this Contract to comply with local, county, state and federal codes, statutes, rules and regulations. The Contractor's work on this project must be in accordance with each statute and the cost of compliance (including inspection fees, review fees, permits, certificates and required course of work) must be included in the Contractor's bid price.

B. Comply with all local Codes. Comply with requirements of the local Authority Having Jurisdiction.

C. Work is to conform to all applicable Reference Standards as indicated above. If an above-named code has been replaced by an updated version and has been adopted by the authority having jurisdiction, the Contractor will be held responsible for complying with the same.

D. Materials and equipment under the Contract are to be new and bear the Underwriter's Laboratories label wherever a standard has been established by that agency.

1.9 INSPECTIONS, PERMITS, LICENSES AND FEES

A. Contractor at his own expense shall make any tests directed by an inspection authority or by the Owner's Representative and shall provide all equipment, instruments and materials to make such tests.

1.10 WARRANTY

A. Include the below provisions as part of the contract warranty unless more stringent provisions are included within the General Conditions .

1. The Contractor is to guarantee for a period of one (1) year from the date of final acceptance that material and workmanship furnished under the Contract are free from defects. The Contractor is to replace any equipment or material found defective within the guarantee period at no cost to the Owner.

2. The Contractor is to, during the guarantee period, be responsible for the proper adjustments of systems, equipment and apparatus installed by him and do work necessary to ensure efficient and proper functioning of the system and equipment.

3. Warranty and Guarantee Manual: Upon completion of this portion of the Work, and as a condition of its acceptance, provide copies of completed warranty cards that are to be sent back to equipment manufactures for all equipment with extended warranties, including all pumps, chillers, controls, etc Include copies of these warranty cards within the above O&M Manual.

4. Manufacturers' Warranties:

   a. Refer to specific Division 23 sections for information regarding manufactured equipment warranties

   b. Where the duration of a manufacturer's standard warranty exceeds that specified, the manufacturer's warranty shall take precedence.

   c. In the event that a manufacturer's warranty expires prior to the expiration of the above contractor's guarantee, the warranty shall be extended to the end of the contractor's guarantee without additional expense to the Owner

   d. Where the duration of the manufacturer's standard warranty is less than that specified, the manufacturer is to provide a special warranty extention as required and shall provide a certificate attesting to that extension with the equipment submittal.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor is to furnish equipment, labor, materials, tools, services and facilities necessary for installation of the project, in general, as noted under "Scope" and more fully specified herein. The Contractor is to carefully examine the site, existing conditions, Plans, and Specifications before submitting their proposal as they will be held responsible for the complete installation in every detail.

B. The Contractor is solely responsible for work, material, and equipment furnished for the contract, including those of his subcontractors, until completion of the project and final acceptance. Damaged work or materials are to be replaced. The Contractor is to provide necessary storage sheds for the protection of the material and equipment for the Contract. Storage sheds are to be located per the approval of the Owner.

C. The Drawings are indicative of the character and scope of the work and are not intended to show each of the details. Before commencing work, the Contractor is to carefully examine all Contract

Drawings and Specifications. If any discrepancies occur between the Drawings, or between the Drawings and Specifications, he is to report such discrepancies to the Architect in writing and obtain written instruction as to the manner in which to proceed. No departures from the contract drawings are to be made without prior written approval of the Architect.

D. During the course of construction, conflicts and discrepancies which the Contractor failed to notify the Engineer of are to be interpreted by the Engineer so as to obtain a consistent and workmanlike installation. The Contractor is bound by the Engineer's decision and is to carry out the work at no additional cost to the Owner.

E. Construction is to be executed with the maximum speed consistent with good workmanship.

F. Material and equipment to be furnished under the Contract is to be new and conform to the grade, quality, style, size and standards as specified herein. Equipment is to be the latest standard product as advertised in printed catalogs by reputable manufacturers for the purpose intended and have replacement parts available.

G. Equipment, material or apparatus of any one system is to be the product of one manufacturer, or equivalent products of a number of manufacturers which are suitable for use as indicated in the various systems. Similar equipment, material or apparatus of the same or similar type are to be as manufactured by the same manufacturer.

H. Equipment is to be installed in strict accordance with the manufacturer's instruction for type and capacity of each piece of equipment. The Contractor is to obtain these instructions from the manufacturer and include same with the submission of the equipment. Type, capacity, and application of equipment are to be suitable and capable of satisfactory operation for the purpose intended.

I. The Contractor is to give requisites, notices, obtain and pay for permits, and pay deposits and fees necessary for the installation tests and inspection of work provided under this Specification. These tests are to be conducted as required by the regulations of the Local and/or State authorities.

3.2 PROJECT MANAGEMENT

A. Management of the project is to be provided. It is essential that such management is provided, for without it, poor quality, waste, shortcuts and delays will result. It is important the work of this project be completed during the period specified.

3.3 COORDINATION

A. The Contractor is to cooperate with other contractors and arrange the work to eliminate confliction with the conduit, piping and equipment of other contracts.

B. Although the Drawings are to be indicative of general routings, the actual location of pipes and equipment are to be determined at the site. The Contractor is to confer with the various other contractors on the project as to the locations of different lines of pipes, ducts, and equipment installed under other contracts before erecting any work in order to avoid interference. The Contractor is to insure proper securing and anchoring of work.

C. Changes necessary due to lack of coordination or because of poor workmanship are to be made at no additional cost to the Owner, i.e., should any Contractor proceed with the installation of equipment, pipe, etc., prior to coordinating with the other contractors and that equipment, pipe, etc., prevents proper installation of work of other trades, the offending Contractor is to remove and replace his work at his own cost.

D. Where the Heating Contractor is installing new electrically operated equipment he is to furnish to the Electrical Contractor (or Sub-Contractor) pertinent information regarding electrical requirements of the motor operated and electrical control equipment to be furnished under the contract. Information is to include electrical characteristics, exact rough-in dimensions, information on remote control equipment, special instructions of the manufacturer and wiring diagrams if required.

E. Connections to equipment is to be made in a neat and workmanlike manner, placing the equipment in proper operating condition, with suitable provisions for maintenance or replacement, when available, the equipment manufacturer's recommendations are to be followed in making final decisions.

F. Coordination drawings are required in all mechanical rooms.

3.4 RECEIPT OF EQUIPMENT

A. New equipment being used on this project, whether delivered to jobsite or to this Contractor’s place of business, is to be examined (to determine if the equipment was damaged) prior to signature of receipt by the Contractor’s representative. It is the Contractor’s responsibility to file damage claims with the mover (truck, railroad, etc.) at time of receipt of damaged equipment.

3.5 PROTECTION OF EQUIPMENT

A. It is to be the responsibility of the Contractor to protect equipment, piping, insulation, controls and similar items of equipment from dirt, grime, plaster and water during each phase of construction. This protection is to be provided by covering with transparent plastic sheeting, caps or as required to the satisfaction of the Engineer.

3.6 STORAGE OF MATERIAL

A. The Contractor is to erect and maintain proper facilities for protecting materials and equipment furnished under this Contract during each phase of construction until acceptance by the Engineer. Any damaged materials or equipment is to be repaired or replaced by the Contractor at his own expense to the satisfaction of the Engineer and the Owner.

3.7 INTERRUPTION OF EXISTING SERVICES

A. Whenever it becomes necessary to shut down existing services (HVAC, Plumbing, or Electric) in order to make a new connection during the course of the work, the Contractor is to secure the Owner's permission prior to the shutdown and is to arrange the time of such outing to minimize inconvenience to the Owner.

3.8 EXISTING EQUIPMENT BEING REMOVED

A. Where existing equipment is to be removed under this contract, it is to remain the property of the Owner and is to be relocated to an onsite location or hauled away as directed by the Owner. The Contractor is to meet with the Owner as soon as possible after the signing of the Contract to determine what equipment the Owner will retain.

3.9 ELECTRICAL REQUIREMENTS FOR EQUIPMENT INSTALLATION

A. Unless specified as being furnished by the equipment manufacturer as an accessory with the equipment, the Heating Contractor is to furnish starters and disconnect switches for each electrically operated piece of equipment specified under this Contract. Disconnect switches are to be fused or non-fused as noted on the plans or as required by the National Electric Code. Starters are to be as herein specified.

B. Where disconnect switches and starters are not factory installed, they are to be unit mounted or wall mounted by the Heating Contractor. Locations for disconnect switches and other control devices may not be indicated on the plans. Coordinate locations with the Owner.

C. The HVAC Contractor is to wall mount disconnect switches, starters, start-stop switches, etc., in the close vicinity of the equipment being controlled. The Electrical Contractor is to power wire to (and through where required) these devices and is to final connect power wiring to electrically operated equipment being installed by the Heating Contractor. The Heating Contractor is to furnish Shop Drawings of approved electrically operated equipment to the Electrical Contractor for his use. Any changes required to accommodate approved substitute equipment such as larger wire, conduit, breakers, etc., are to be the financial responsibility of the Heating Contractor.

D. DO NOT LOCATE DISCONNECT SWITCHES OVER EQUIPMENT NAME PLATES.

E. Temperature control component such as thermostats, sensors, sensing wells, interlocking relays, and other temperature regulating controls as well as control wiring, incidental power wiring, conduit, etc., as required by this Specification, are to be furnished and installed by the Heating Contractor or his/her ATC Sub-Contractor.

F. Electrical equipment, components and wiring furnished and installed by the Heating Contractor are to conform to the following electrical requirements, codes and regulations:

1. Underwriter's Labels: Where applicable, materials and equipment are to bear the label as listed by the National Board of Fire Underwriter's Laboratory.

2. Regulations: Electrical installation is to meet the requirements of the National Electrical Code of National Board of Fire Underwriters amended to date. In addition, any State, Municipal or other Authority's laws, regulations or rules applicable to the work are to be followed.

G. Any contactor or starter to which line voltage exceeds 120 volts and which is provided for equipment which will be controlled by automatic temperature control system is to be provided with 120 volt control transformer wired to line side of contactor or starter.

H. Three phase starters may be separate or combination starters/disconnect switches and whether furnished by the equipment manufacturer or by the Contractor, are to have under voltage and phase loss/reversal protection.

I. Any contactor or magnetic starter for equipment, which when energized, is required to energize other equipment, is to be provided with the number of sets of auxiliary contacts required, plus one spare.

J. All wiring is to be AWG copper, Type THW, THHN or THWN and installed in electrical metallic tubing (EMT) except where conduit is run outside the building in which case it is to be installed in rigid galvanized conduit.

K. Each piece of conduit is to be straight, free from blisters and defects, cut square and taper reamed and is to be furnished in 10'-0" lengths with approved couplings and fittings.

L. Short runs of flexible steel conduit is permitted for final connection to motors. Length of flexible conduit is not to exceed 48".

M. Each control cabinet, starter pushbutton station, and manual switch controlling equipment furnished under this Contract is to be identified by means of a name tag with the name, function and location of the equipment stated thereon. Name tags are to be made of rigid plastic laminate with engraved letters. Name tags are to be attached with small chrome plated screws.

3.10 SUPPORT FOR DUCTS, PIPES & EQUIPMENT

A. All pipes and equipment that are suspended shall be connected directly to the building structure.

B. Pipe shall not be supported from other pipes, ducts, or equipment. Hanging shall not be permitted from the roof and floor slabs.

C. Hangers from joists shall be attached at the panel points. Pipes and ducts with weights of 50 pound per foot (total for single or multiple runs), routed parallel with bar joists, shall be supported from a minimum of 3 joists at each hanger point (channel members between joists).

D. Where ceiling or wall mounting of equipment is indicated or specified, use suspended platform or strap hangers, bracket or shelf, whichever is most suitable for equipment and its location, unless indicated otherwise on the Drawings. Construct of structural steel members, steel plates, hanger rods, etc., as required or as indicated on the Drawings. Brace and fasten to building structure or to inserts as approved by the Engineer.

E. Equipment suspension assemblies are to be constructed of supporting members of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over building areas. Conform to applicable technical societies standards and to codes and regulations of all agencies having jurisdiction.

F. The Contractor is to submit detailed Drawings for all supports and obtain approval before fabricating or constructing.

G. Hanger rods, angle iron, wall brackets, etc., installed concealed in the building to provide supports for new equipment is to be shop coat primered.

3.11 VIBRATION ISOLATION

A. Isolation mounting shall be provided for all moving equipment where the energy of the vibration is of sufficient magnitude to produce perceptible vibration or structure transmitted noise in occupied areas. Isolation equipment shall be selected, installed and adjusted in accordance with manufacturer's recommendations.

B. All equipment and material shall be installed to operate without objectionable noise or vibration as determined by Architect and Owner. Should such objectionable noise or vibration be produced and transmitted to occupied portions of the building by apparatus, piping or other parts of this work, any necessary changes as approved shall be made by the Contractor.

C. Provide Vibration Isolation kits, and all accessories such as threaded rods or other hangars, for all items as recommended by manufacturer.

3.12 PAINTING AND MARKING OF PIPING AND EQUIPMENT

A. Piping, iron work and other equipment installed exposed under this contract throughout the building are to be painted with one (1) coat primer and two (2) coats of the best quality finish paint of colors as selected by the Engineer. Finish coats are to be flat or semi-gloss as directed by the Engineer. Piping covered with white insulation is not to be painted but is to be stenciled.

B. Piping is to be stenciled every 20'-0" and at each change of direction with flow arrows and the Owner's standard legend. Where standard legends have not been developed, commercially available pipe markers as manufactured by Seton (or approved equivalent) will be accepted, or stencil. Stenciling is to match the following legend unless a standard has already been established:

1. CWS - Chilled Water Supply Piping
2. CWR - Chilled Water Return Piping
3. CoWS - Condenser Water Supply Piping
4. CoWR - Condenser Water Return Piping

3.13 DIRT, NOISE AND CLEAN-UP

A. The Contractor is to keep the building free of rubbish and material during the course of construction insofar as his work is concerned.

B. The exterior and interior premises of the building are to be kept as clean as possible during the entire construction. Weekly clean-up will be mandatory.

C. When, in the opinion of the Engineer, any accumulation of material is obstructing construction progress, the Contractor is to immediately remove such material.

D. Upon completion of the project, the Contractor is to remove rubbish, surplus equipment, etc., and have each area cleaned spotless to a standard as approved by the Engineer.

E. The Contractor is to thoroughly clean equipment, leaving same in first-class working condition, clean permanent filters and install clean, throw-away filters into each piece of equipment.

3.14 OPERATIONS AND MAINTENANCE MANUAL (O&M MANUAL)

A. Operations and Maintenance Manual: The Contractor is to furnish the Owner with three (3) copies of a bound "Operations and Maintenance Manual" containing complete operating instructions, manufacturer's catalog numbers and complete description and parts list of each piece of equipment furnished under the Contract.

1. Include within the O&M Manual a Letter of Certification (copy available upon request) itemizing the equipment, system, instructor and bearing signatures of the employees instructed. The Letter of Certification is to note the number of hours spent in explanation and actual operation of system with maintenance personnel. The letter is to be delivered to the Owner upon completion of the project.

2. The Contractor is to videotape all portions of the training and turn over to the Owner for their future use.

3. Provide a completed start-up checklist report for each piece of equipment listed in the below table. The start-up checklist is to be provided by the manufacturer of the equipment or an approved source (ASHRAE, BCA, etc.). The start-up checklist is to be completed by a technician as described below and who has experience in the start-up of the indicated equipment. The checklist is to be dated and signed by the technician who performed the start-up.

	Equipment	Checklist Provided by	Checklist completed by
a.	Chillers	Manufacturer	Factory Certified Rep.
b.	Pumps	Manufacturer	Factory Certified Tech.
c.	TAB Report	TAB Sub-Contractor	Tab Sub-Contractor
d.	ATC	ATC Sub-Contractor	ATC Sub-Contractor

4. For the purposes of the above checklist, the following definitions apply:

a. Factory Certified Representative: A start-up technician employed by the manufacturer whose duty is to start-up the equipment and is not responsible for or involved with the installation.

b. Factory Certified Technician: A person trained by the manufacturer and having completed specialized training with respect to the equipment but who is employed by a start-up company of the installing Contractor and who may or may not have been involved with the installation. Proof of certification is required.

c. Contractor: An employee or a Sub-Contractor of the Contractor who is not required to have specialized factory provided training but who should possess fundamental knowledge of the system being started up and experience requisite of the tasks being performed.

3.15 INSPECTIONS

A. The following operations are to be performed in preparation for final inspection. This Contractor is to demonstrate to the Owner and the Engineer that all new equipment is operating in compliance with the Drawings and Specifications.

1. Machinery: Machinery is to be initially serviced. Machinery is to be test operated and necessary adjustments made to make it perform in compliance with the Drawings and Specifications.

2. Controls: All controls will be tested and adjusted by the Heating Contractor or his/her Automatic Temperature Control Sub-Contractor to achieve the intent of these Specifications. When possible, controls are to be adjusted while the system is operating under full load conditions.

3. TAB Report: Testing, Adjusting and Balancing is to be completed and initial forms submitted to the Architect for review prior to final inspection. See Section 23-05-93 – Testing, Adjusting and Balancing.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 PRODUCTS

1.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.

2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.

4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.

   a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

   b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Prefabricated Trapeze-Framed Metal Strut Systems:

1. Strut Channel or Bracket Material:

2. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

C. Hanger Rods:

1. Threaded zinc-plated steel unless otherwise indicated.

D. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of hydronic systems.

B. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).

C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.3 SUBMITTALS

A. See Section 230500 for submittal procedures.

B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.

2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

5. Units of Measure: Report data in I-P (inch-pound) units only.

1.4 QUALITY ASSURANCE

A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section certified by NEBB or AABC.

B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance of NEBB Procedural Standards for testing, Balancing and Adjusting of Environmental Systems.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

3. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Certified by one of the following:

a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.

b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.

c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

E. Pre-Qualified TAB Agencies:

1. Hydrair Balance Company, Inc - Contact Roger Miller 724 662 4300

2. Peno Balancing Company, Inc - Contact Craig L. Harter 814 364 2094

3. _____.

4. _____.

5. _____.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Hydronic systems are flushed, filled, and vented.

5. Pumps are rotating correctly.

6. Proper strainer baskets are clean and in place.

7. Service and balance valves are open.

3.3 ADJUSTMENT TOLERANCES

A. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

END OF SECTION

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2017.

B. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023b.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).

E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.2 SUBMITTALS

A. See Section 230500 for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, RIGID

A. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.

1. Maximum Service Temperature: 650 degrees F (343 degrees C).

2. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/(Pa s m)).

C. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.3 JACKETING AND ACCESSORIES

A. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. Inserts and Shields:

1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert location: Between support shield and piping and over the finish jacket.

4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

F. Pipe Exposed in Mechanical Equipment Rooms: Finish with canvas jacket sized for finish painting.

END OF SECTION

SECTION 23 09 93 – SEQUENCE OF CONTROL FOR HVAC

PART 1 GENERAL – NOT USED

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Utilize the existing control system and maintain all existing points associated with the work area. As part of the Automatic Temperature Control system submission, include a list of the existing points associated with the current installation and screen shots of the existing graphics for review along side the new proposed system.

3.2 REFRIGERANT MONITOR

A. This system consists of a new refrigerant monitor panel and all new refrigerant sensors. The new panel will be installed in the same location as the existing panel and the new sensors will be installed as required per ASHRAE 15 and the chiller manufacturer requirements.

B. Utilize the existing exhaust fan and interlock operation of the exhaust fan to energize when the refrigerant monitor detects a leak in the chiller room. Provide an alarm to the ATC and energize the new Audible/Visual Alarm. This alarm sequence is also to shut down all chillers, cooling towers and associated chilled water and condenser water pumps.

3.3 COOLING TOWER

A. The sequence of control for the existing cooling tower is to remain as is. Provide any referenced interlocks indicated here in.

3.4 CHILLED WATER SYSTEM

A. Utilize the existing control sequence and the sequence indicated on Drawing M-18 from the original installation dated April 26, 1996 to stage the new chillers and control the associated pumps. This Sequence is retyped under section 3.5 below.

B. Incorporate into the original sequence the variable speed compressors included in this design and ramp the compressor speeds to match the building load as required. Once a Chiller 1 reaches 80% of its full load capacity, stage on the second chiller and ramp each chiller up together (starting at 40% each) to continue matching the building load. As building load decreases, allow each chiller (operating in tandem) to decrease to their minimum operating capacity before staging off the second chiller.

C. Rotate the lead chiller every 30 days or after 500 hours of runtime.

D. Utilize the existing pressure differential control to operate the new chilled water pumps as in the original sequence of control.

3.5 ORIGINAL COOLING SYSTEM CONTROL

A. General

1. Chillers CH-1 and CH-2 integral controls shall maintain the chilled water supply temperature at 45°F (adjustable at the chiller integral control panel). Hand off-auto switches shall be located on all chilled water and condenser water pump motor starters (by others) associated with the chiller system in the auto position where the pumps will be controlled by the EMCS.

B. Sequence of Operation - Chiller Starting Sequence

1. When outside air temperature rises above 52°F (adj.) the EMCS shall command chilled water pump #1 on separate current sensing relays shall indicate proper operation of the pumps.

2. Once chilled water pump #1 operation is proven the EMCS shall command condenser water pump #1 on proof of operation shall be the same as for the chilled water pump.

3. After 5 minutes (adj.) if the chilled water and condenser water pumps have proofed through their respective current switches the EMCS shall enable CH-1 to start. After a 5-minute delay (adj.) for startup, the EMCS shall look at CH-1's load for proof of start. CH-1 is proofed when percent load is greater than 25% (adj.) based on amp draw and the chilled water supply temperature is less than 48°F (adj.). This proof starts a 30-minute (adj.) minimum run time.

4. When the outside air temperature falls below 48°F (adj.) and CH-1's minimum run time has been satisfied, CH-1 will be disabled by the EMCS. After a 30-second adjustable time delay, chilled water pump #1 and condenser water pump #1 shall shut down.

5. If chilled water pump #1 or condenser water pump #1 do not proof, or if chiller #1 does not proof, command chilled water pump #2, condenser water pump #2 and chiller #2 similarly as indicated in paragraphs 1 through 4 above.

6. The EMCS shall monitor common chilled water supply flow and the chilled water supply and return temperatures for each chiller when the calculated load on CH-1 exceeds the tonnage setpoint (based on CHW supply flow and the difference in temperature between chilled water supply flow and return). The EMCS shall start chilled water pump #2 and condenser water pump #2, when the pumps are proofed via their current switches. The EMCS shall enable CH-2 after five-minute delay. The EMCS shall look at CH-2's load for proof of start. CH-2 is proofed when percent load is greater than 25% (adj.) based on amp draw. This proof starts a 30-minute (adj.) run time.

7. After CH-2 has been proofed and CH-1's minimum run time of 30 minutes has been satisfied, CH-1 chilled water pump #1 and condenser water pump #1 shall be shut down by the EMCS. If CH-2, chilled water pump #2, or condenser water pump #2 indicates failure through the EMCS then the CH-1 system shall be re-commanded on and run its sequence.

8. When calculated load on CH-2 exceeds the tonnage setpoint the EMCS shall utilize CH-1 and its related pumps in addition to CH-2 to satisfy the building cooling and load, as the

calculated load decreases CH-1 and its pumps shall be commanded off (provide the minimum run time is met).

9. If calculated load further decreases the EMCS shall enable CH-1 and its pumps and disable CH-2 and its pumps following a similar start/stop and proofing sequences as previously specified.

10. All EMCS point alarms, pump failures, water temperatures out of range and the general alarm contacts at the chiller control panel, shall initiate an alarm at the operator's terminal and be recorded on the EMCS report alarm printer.

11. A system graphic shall be provided for the complete chilled water system, and all control points shall be commandable from the operator's terminal.

C. Chiller water differential pressure control

1. The differential pressure bypass valve shall be modulated to maintain system differential pressure setpoint. The EMCS shall receive a signal from the differential pressure transmitter installed across the chilled water supply and return piping each of the following modes of operation shall have a separate differential pressure setpoint.

MODE 1: CH-1 ON CH-2 OFF

MODE 2: CH-1 OFF CH-2 ON

MODE 3: CH-1 ON CH-2 ON

D. Chiller features

1. After the five-minute delay on startup if chiller does not proof chiller #2 shall be enabled in place of the failed chiller with chiller #1's sequence of operation on alarm shall be initiated through the EMCS system.

E. Building power bump or outage

1. In the event that the building has a power bump or outage bring the chillers back online as needed 2 minutes apart from each other.

F. Safeties for chillers

1. If at any time the condenser water supply temperature exceeds 100°F (and is sensed by the condenser water supply temperature sensor the chillers shall be shut down and locked out) the chillers shall not be sequenced to restart until the condenser water supply temperature falls below 85°F (adj.).

G. Cooling tower sequence

1. Each cooling tower and associated isolation valves shall be interlocked with its associated chiller and condenser water pump.

2. When a chiller is energized the associated isolation valves shall open and if the condenser water supply temperature is above 75°F and the bypass valve shall be opened to the towers, and the cooling tower fans shall cycle (max. 6 starts per hour to maintain 75°F condenser water supply temperature (coordinate minimum condenser water temp with chiller manufacturer).

   At any time should the condenser water supply temperature fall to 70°F or below the bypass valve shall close to the tower's water shall then be circulated with the bypass valve closed to the towers and the cooling tower fans off until the condenser water temperature reaches 85°F above which point the bypass valve shall open to the towers and fans shall be cycled as previously described.

3. The cooling tower fans shall be proofed via current sensing relays.

4. Cooling tower fan failure and condenser water temperatures out of range shall cause an alarm to be initiated at the operator's terminal and be printed on the system alarm report printer.

5. A system graphic shall be provided for this system all control points shall be commandable from the operator's terminal.

6. The ATC/EMCS contractor shall perform the basin heater and tower flow valve control interlock wiring basin heater equipment and tower fill valve are proved under other sections.

END OF SECTION

SECTION 232113 - HYDRONIC PIPING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Section 230516 - Expansion Fittings and Loops for HVAC Piping.

1.2 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

E. ASME B31.9 - Building Services Piping; 2020.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

G. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2018.

H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

I. ASTM B32 - Standard Specification for Solder Metal; 2020.

J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

L. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.

M. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

N. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

P. AWWA C606 - Grooved and Shouldered Joints; 2015.

Q. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.3 SUBMITTALS

A. See Section 23-05-00 - Common Work Results for HVAC for submittal procedures.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.

2. Provide manufacturers catalogue information.

3. Indicate valve data and ratings.

4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.4 QUALITY ASSURANCE

A. All steel piping installed under this contract is to be fabricated and erected in accordance with the most currently adopted and amended American Standard Code for Pressure Piping (A.S.A.) B31.1.

B. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

C. Grooved Joints: Install in accordance with the manufacturer’s latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

E. Welding is to be done in accordance with the recommendations of the ASME Code for pressure piping and the American Welding Society. Welding is to be done by welders experienced in this type of work and work must be performed to the entire satisfaction of the Engineer.

F. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1. Qualifications of Pipe Welders: Before assigning any welder to work covered by this Specification, the Contractor is to provide the Engineer with the names of pipe welders to be

employed for the work, together with the certification that each of these welders has passed qualification tests as prescribed by the National Certified Pipe Welding Bureau, or by other reputable testing laboratory or agency, using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. If requested by the Engineer, the Contractor is to submit identifying stenciled test coupons made by any operator in question. The Contractor is to require any welder to retake a test when, in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to his proficiency. Tests, when required, are to be conducted at no expense to the Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.

2. Use non-conducting dielectric connections whenever jointing dissimilar metals.

3. Grooved mechanical joints may be used in accessible locations only.

a. Grooved mechanical connections and joints comply with AWWA C606.

1) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.

b. Use rigid joints unless otherwise indicated.

4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:

1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, and at equipment. Use 3/4 inch (20 mm) gate valves with cap; pipe to nearest floor drain.

2. On discharge of condenser water pumps, use spring loaded check valves.

3. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.

4. For throttling and isolation service in chilled and condenser water systems, use only butterfly valves.

2.2 CHILLED AND CONDENSER WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:

1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

2. Threaded Joints: ASME B16.3, malleable iron fittings.

3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type M (C), hard drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.

a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.

2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.

3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type M (C), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis.

3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

4. Wall Support for Pipe Sizes 4 Inches (100 mm) and Greater: Welded steel bracket and wrought steel clamp.

5. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

8. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.5 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches (50 mm) and Less:

B. Flanges for Pipe 2 Inches (50 mm) and Greater:

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.

2. Mechanical Couplings: Comply with ASTM F1476.

3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.

4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections:

1. Flanges:

    a. Dielectric flanges with same pressure ratings as standard flanges.

    b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.

    c. Dry insulation barrier able to withstand 600 volt breakdown test.

    d. Construct of galvanized steel with threaded end connections to match connecting piping.

    e. Suitable for the required operating pressures and temperatures.

2.6 BALL VALVES

A. Over 2 Inches (50 mm):

1. Ductile iron body, chrome plated stainless steel ball, teflon or Virgin TFE seat and stuffing box seals, lever handle or gear operated, flanged ends, rated to 800 psi (5515 kPa).

2.7 BUTTERFLY VALVES

A. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.

B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, or ductile iron with EPDM encapsulation.

C. Operator: 10 position lever handle.

2.8 SWING CHECK VALVES

A. Over 2 Inches (50 mm):

1. Iron body, bronze trim, stainless steel, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged or grooved ends.

PART 3 EXECUTION

3.1 GENERAL

A. Installation is to be made in a workmanlike manner, according to the best practice of the trade, properly pitched and vented to eliminate air pockets or traps and to insure a rapid and noiseless circulation throughout.

B. Pipes are to be cut accurately to measurements established at the building and be worked into place without springing or forcing, properly clearing windows, doors and other openings.

C. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted.

D. Threaded pipe is to have full clean-cut threads. Pipes are to have burrs removed by reaming.

E. Pipe is to be installed so as to provide proper drainage to permit free expansion and contraction without causing damage.

F. High points of piping are to be fitted with manual air vents.

G. Drain valves are to be provided at low points for drainage of the system.

H. Changes in direction are to be made with fittings.

I. Open ends of pipe lines and equipment are to be properly capped or plugged during the installation to keep dirt and other foreign matter out of the system.

J. Pipe is to be thoroughly cleaned before erection and must be cleaned after erection to remove any foreign material.

K. Piping is to be installed concealed unless shown otherwise on the Drawings. Where piping is not concealable, run neatly as high as possible parallel with the building walls and/or other systems.

L. Because of the small scale on the Drawings, it is not possible to indicate offsets, fittings, valves or similar items which may be required to make a complete operating system. The Drawings are generally diagrammatic and indicative of the work to be installed. The HVAC Contractor is to carefully investigate conditions affecting his work and install his work in such a manner that interference between pipes, conduit, ducts, equipment, architectural and structural features will be avoided, and the Contractor is to furnish and install such offsets or fittings as may be required to meet the conditions at the building and avoid such interference.

M. Water supply and return piping mains are to be installed level or pitched up slightly in direction of flow. High points are to be vented, install drains at low points. NOTE: Not all vent and/or drain locations are shown on the Drawings. Install manual air vents at all piping high points. Branch off-takes are to be top connections for up-fed equipment and bottom connections for down-fed equipment either 45° or 90° as required.

N. Piping is not to be routed over any motor, switchboard or other electrical equipment, except piping may be located above light fixtures.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Route piping in orderly manner, parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and to avoid interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Slope piping and arrange to drain at low points.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Grooved Joints:

1. Install in accordance with the manufacturer's latest published installation instructions.

2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

H. Pipe Hangers and Supports:

1. Provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and accessories.

2. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.

3. Support horizontal piping as scheduled.

4. Perforated band iron, wire or chain will not be permitted for hangers or support pipes.

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

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

7. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

8. Provide insulation sheilds outside of the insulation for piping carrying media less than 60F. Spot weld sheild to hanger. Care is to be taken to avoid damaging the vapor barrier of insulated cold piping during installation.

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

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

I. Use eccentric reducers to maintain top of pipe level.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

K. Supplementary steel required for the installation of piping hangers and supports is to be furnished and installed by the HVAC Sub-Contractor and receive one (1) shop coat of primer paint and one finished coat white. Hangers exposed in finished areas without ceilings are to be painted to match ceiling or walls unless otherwise directed.

L. Install valves with stems upright or horizontal, not inverted.

3.3 FREE PIPE EXPANSION

A. Unless indicated otherwise on the Drawings, horizontal runs of water piping are not to be anchored to any building structural member. Instead, piping as designed with offsets in horizontal runs, is so designed to be installed to allow for free expansion in every direction by the use of swing joint connections. Pipe hangers are to serve to locate pipe and guide expansion.

3.4 ELECTROLYSIS CONTROL

A. Where iron or steel pipe meets copper pipe (any piping system) install dielectric (insulating) fittings as manufactured by Grabler Manufacturing Company or approved equivalent. Also, where copper pipe may come in contact with ferrous metal, insulate pipe with rubber, plastic or similar material.

3.5 TESTING WATER PIPING SYSTEMS

3.6 FLUSHING AND CLEANING WATER PIPING SYSTEMS

A. Refer to Section 23-25-00 HVAC Water Treatment for requirements.

B. Fill, vent and circulate entire system with an environmentally acceptable cleaning solution. Allow water to reach design or operating temperatures, if possible. After system has been circulated for four (4) hours, system is to be drained completely and refilled with clean water, circulated for another one (1) hour, flushed again and then refilled with clean water. System is to be thoroughly vented of all air.

END OF SECTION

SECTION 23 21 14 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SUBMITTALS

A. See Section 230500 for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 AIR VENTS

A. Furnish and install air vents on high points of piping systems and where indicated on the Drawings as required for proper elimination of air from the piping system.

B. Manual air vents are to be key operable Bell & Gossett No. 17SR.

C. Automatic air vents are to be Amtrol Model No. 720 (Bell & Gossett or approved equivalent).

2.2 STRAINERS

A. Strainers are to be installed at locations indicated on the Drawings and at the inlet of all primary pumps.

B. Strainer bodies are to be cast iron or cast semi-steel except that in pipe sized 1" and smaller, bronze bodies may be furnished for pressure under 125 psi. The rated safe working pressure of strainer bodies is to be the same as specified for fittings in the corresponding pipe lines. Strainers 2" and larger are to have flanged ends.

C. Screens are to be stainless steel. Screens are to be removable. The free area through the strainer is not to be less than 1.5 times the pipe area and be rated by the manufacturer for service intended.

D. Furnish and install blow-down valves of the proper pressure rating for strainers. Valves are to be full size of blow-down connection with a hose connection.

E. Strainer screens are to be removed after temporary or warm-up period, washed thoroughly in detergent and replaced for normal service.

2.3 SUCTION DIFFUSERS

A. Furnish and install at locations shown on the Drawings, a suction diffuser to change flow direction 90° and of the size required to reduce from line size to pump suction size. Suction diffusers are to be flanged FLG model as manufactured by Bell & Gossett or "Suction Guides" as manufactured by Armstrong.

B. Suction diffusers are to be steel body with 175 psi maximum working pressure and 250°F maximum working temperature.

C. Suction diffusers are to have galvanized steel conical screen diffuser. Screen is to be easily removable by removing blow down plug.

D. Suction diffusers are to have a disposable fine mesh bronze screen strainer for initial system protection. The Contractor is to inspect the strainer prior to activating the pump and is to remove the fine mesh start-up strainer after a short running period (24 hours maximum). Space is to be provided for removal of the strainer and connection of a blow down valve.

E. Suction diffusers are to have a straightening vane at the outlet to restore laminar flow to the pump's impeller.

F. Fitting: Angle pattern, cast-iron body, threaded for 2 inch (50 mm) and smaller, flanged for 2-1/2 inch (65 mm) and larger, rated for 175 psi (1200 kPa) working pressure, with inlet vanes, cylinder strainer with 3/16 inch (5 mm) diameter openings, disposable 5/32 inch (4 mm) mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

2.4 PUMP CONNECTORS

A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.

1. Maximum Allowable Working Pressure: 150 psig (1030 kPa) at 120 degrees F (49 degrees C).

2. Accommodate the Following:

a. Axial Deflection in Compression and Expansion

3. End Connections: Same as specified for pipe jointing.

4. Provide necessary accessories including, but not limited to, swivel joints.

2.5 TRIPLE DUTY VALVES

A. Furnish and install as shown on the Plans, angle or straight pattern triple duty valves. Each valve is to be designed to perform the functions of non-slam check valve, throttling valve, shut-off valve, calibrated balancing valve and system flowmeter.

B. Each valve is to be equipped with brass readout valves with integral check valves for taking differential pressure readings across the orifice to accurately balance the system to specified design conditions.

C. Each valve is to be furnished with a pre-formed removable PVC insulation jacket to meet ASTM D1784 Class 14253-C, MEA #7-87, ASTM-E-84 and ASTM136 with a flame spread rating of 25 or less and a smoke development rating of 50 or less. There will be provided sufficient mineral fiberglass insulation to meet ASHRAE 90.1 – 1989 specifications in operating conditions with maximum Fluid Design Operating Temperature Range of 141°F - 200°F (60°C - 93°C) and Mean Rating Temperature of 125°F (52°C). Seal all joints airtight to prohibit condensation.

2.6 FLOW METERS

A. Orifice principle by-pass circuit with direct reading gauge, soldered or flanged piping connections for 125 psi (860 kPa) working pressure, with shut off valves, and drain and vent connections.

B. Direct reading with insert pitot tube, threaded coupling, for 150 psi (1034 kPa) working pressure, maximum 240 degrees F (115 degrees C), 5 percent accuracy.

C. Cast iron, wafer type, orifice insert flow meter for 250 psi (1720 kPa) working pressure, with read-out valves equipped with integral check valves with gasketed caps.

D. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer.

E. Portable meter consisting of case containing one, 3 percent accuracy pressure gauge with 0-60 feet (0-180 kPa) pressure range for 500 psi (3450 kPa) maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. Provide valved drain and hose connection on strainer blow down connection.

D. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

END OF SECTION

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 23 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Separately coupled, Base Mounted End Suction centrifugal pumps.

1.3 DEFINITIONS

A. CSC: Carbon vs. Silicon Carbide

B. STC: Solid Tungsten Carbide

1.4 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves. Pump shall be non-overloading throughout the operating curve.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Pump Manufacture shall be ISO certified, and Six Sigma rated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion solution after assembly and testing. Protect flanges, pipe openings, and nozzles with plastic cover over entire pump.

B. Store pumps in dry location. Rotate Motor & Impeller routinely for long storage periods.

C. Retain protective covers for flanges and protective wood crates and plastic wrap during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal and volute gasket for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SEPERATELY COUPLED, BASE MOUNTD, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:

1. Patterson Pump Company

2. Bell &Gossett; Div. of ITT Industries.

3. Wilo Pumps

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close coupled, in-line pump as defined in Hi 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 170-psig maximum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction: Casing: Back Pull-out design, cast iron class 30, with threaded gage tapping at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections ASTM A48-CL30.

1. Casing wear ring shall be made of Bronze, ASTMB505-932.Impeller: ASTM B584-875, precision cast stainless; statically and dynamically balanced, and keyed to shaft with Stainless Steel Key. Trim impeller to match specified performance. Impeller to be balanced and trimmed by the Pump Manufacture. Impeller attached to Pump motor shaft with a Stainless-Steel bolt and washer.

2. Impeller: ASTM B584-875, stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking stainless steel cap screw. Trim impeller to match specified performance.

3. Pump Shaft: Steel, with bronze shaft sleeve.

4. Mechanical Seal: Carbon rotating ring against a silicon carbide seat held by a 416stainless steel spring, and Buna-N bellows and gasket.

5. Copper flush seal line shall be installed from discharge of pump to seal gland.

6. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings. Bearing housing shall be supported with a steel foot.

D. Shaft Coupling: Duraflex molded split-in-half design and capable of absorbing vibration and suitable for use with Variable Frequency Drive. Couplings shall be split-in-half design to allow disassembly and removal without removing pump shaft or motor.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; PVC hinged type with removable wing nuts for access from either side of coupling without removing guard.

F. Mounting Frame: One piece C-Channel pump base, with factory fabricated stud bolts to mount pump casing, coupling guard, and motor. Grout hole shall be included in base.

G. Motor: JM Frame, variable speed rated, with permanently lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in division 2.3 Section "Common Motor Requirements for HVAC Pumps." Motor shall be a JM Frame Motor.

2.3 COMMON MOTOR REQUIREMENTS FOR HVAC PUMPS

A. Pump motor to be variable speed rated and include Aegis grounding rings. Variable speed drives will be mounted to the motor and pre-wired to each pump by the manufacturer.

B. The pump manufacturer will provide variable speed drives designed for operation with the specified pumps. Each variable speed drive will be equipped with standard motor protection functions including over & under voltage protection.

C. The variable speed drive will have the ability to be controlled by a BMS interface that includes status, alarm, and speed adjustments.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; straightening vanes; drain plug; and factory-fabricated support boss. Diffuser shall accommodate a fully opened Butterfly Valve on the vertical inlet side. Manufactured by Pump Manufacture.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, Pump discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement. Manufactured by Pump Manufacture.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 14.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until the alignment procedure is complete.

1. Support pump base plate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in Hi 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill Base plate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

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

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install Y-Strainer or Suction Diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves with control rods.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Install electrical connections for power, controls, and devices.

K. Ground equipment according to Division __ Section "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Division __ Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Check piping connections for tightness.

3. Clean strainers on suction piping.

4. Perform the following startup checks for each pump before starting:

a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains and prepare pump for operation.

6. Start motor.

7. Open discharge valve slowly.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division __ Section "Demonstration and Training."

END OF SECTION

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 GENERAL

1.1 SUBMITTALS

A. See Section 230500 for submittal procedures.

B. Product Data: Provide chemical treatment materials, chemicals, and analysis report.

C. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

1.2 QUALITY ASSURANCE

A. Utilize Owners existing Chemical Treatment Company or an approved vendor.

PART 2 PRODUCTS

2.1 CHEMICALS FOR WATER SYSTEMS

A. The Contractor is to contact a chemical supplier, as approved by the Owner, and arrange to have that supplier (at the Contractor's expense) make a chemical analysis of the raw water (before treatment) from each system. Water analysis is to be made after systems have been cleaned, flushed and refilled with fresh water. Two (2) copies of the water analysis, along with two (2) copies of the treatment recommended for each system, are to be furnished, with one copy delivered to the Owner and one copy delivered to the Architect.

B. The Contractor is responsible for furnishing and installing (via the existing chemical shot feeder), the initial treatment of chemicals as recommended by the chemical supplier for the chilled water system. Chemicals to be formulated to prevent accumulation of scale and corrosion. NOTE: Maintain pH levels as required by equipment manufacturers. Thereafter, treatment will be the responsibility of the Owner. The Owner's personnel are to be instructed in the testing and adding of chemicals, however, the chemical supplier is to visit the site at three (3) month intervals during the first year to evaluate chemical concentrations.

C. Chemical cost for the initial treatments is to be the responsibility of the HVAC Contractor. Thereafter the cost of chemicals is the Owner’s responsibility.

PART 3 EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

A. Chilled Water Systems:

1. Circulate for 48 hours, then drain systems as quickly as possible.

2. Refill with clean water, circulate for 24 hours, then drain.

3. Refill with clean water and repeat until system cleaner is removed.

4. Vent system of air.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Utilize existing chemical feeder to incorporate chemicals into system.

C. Note: If possible and at the Contractor's discretion, the contractor may isolate the renovated portions of the piping system to avoid draining the entire system during construction but once construction is complete, venting and final chemical treatment of the system is to be performed on the entire building, so the project does not inadvertently affect parts of the system not renovated. All new portions of the piping system are to be flushed and cleaned as specified prior to connection to the remaining building system. This may require the installation of temporary bypasses.

END OF SECTION

SECTION 23 64 16 - WATER-COOLED CENTRIFUGAL WATER CHILLER

PART 1 GENERAL

1.1 REFERENCES

A. ARI 550/590-2003

B. ANSI/ASHRAE 15

C. ASME Section VIII

D. NEC

E. UL

F. CSA

G. OSHA as adopted by each individual State

1.2 SUBMITTALS

A. Chiller dimensional drawings with elevation overview. Drawings to include required service clearances, location of all field installed piping and electrical connections.

B. A summary of all auxiliary utility requirements for normal system operation required. Auxiliary utility requirements include: electrical, water, and air. Summary of auxiliary equipment shall include quantity and quality of each specific auxiliary utility required.

C. Chiller Control documentation to include: Chiller control hardware layout, wiring diagrams depicting factory installed wiring, field installed wiring with points of connection, and points of connection for BAS control/interface points.

D. Sequence of operation depicting overview of control logic used.

E. Installation and Operating Manuals.

F. AHRI certified performance data at full load in addition to either IPLV or NPLV.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the codes and standards as defined in Section 1.02 titled REFERENCES

B. Chiller is required to be run tested at manufacturer's facility prior to shipment. Report to be provided with chiller shipment.

C. All test equipment must be examined before test pressure is applied to any vessel. The QA Tester must ensure that all test fittings are tight and that all low pressure filling lines and other appurtenances which should not be subject to test pressure are disconnected.

1.4 DELIVERY AND HANDLING

A. Chiller shall be delivered “knocked down”. When “knocked down”, chiller to arrive from factory with compressors, control panels, and necessary refrigerant components on skids for reassembly by installing contractor.

B. Installing contractor to comply with the manufacturer’s instructions for transporting, rigging, and assembly of chiller.

1.5 WARRANTY

A. The manufacturer’s standard equipment warranty shall be for a period of (1) One year from date of equipment startup or 18 months from the date of shipment, whichever occurs first.

B. Provide an extended warranty on parts and labor which will extend the original standard warranty for a period of 24 months beyond the expiration of the standard warranty. The warranty shall include parts and labor costs for the repair and or replacement of defects in components or workmanship.

1.6 MAINTENANCE

A. Maintenance of the chiller shall be the sole responsibility of the owner.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Multistack LLC

2.2 PRODUCT DESCRIPTION

A. Provide and install as shown on the plans a factory assembled, charged, and run tested, water-cooled packaged chiller.

B. Each unit shall include: One or more MagLev®, oil-free, magnetic bearing, variable speed two stage centrifugal compressor equipped with intraflow valve for capacity control. Inlet guide vanes are not acceptable unless used with TT compressors deployed in a TT/VTT mixed arrangement. Each compressor to utilize its own, stepper controlled load balance valve. Solenoids for load balancing will not be accepted. Each compressor to utilize its remotely mounted variable speed drive in conjunction with the compressors intraflow valve and load balance valve, to optimize the chillers part load efficiency.

C. Chiller shall have factory installed brazed plate refrigerant to refrigerant sub- cooler/economizer to maximize chiller capacity and efficiency.

D. The chillers evaporator, condenser, and electronic expansion valves shall be common to all compressors. The chiller shall operate with (1) one refrigerant circuit.

E. Chiller shall utilize R-513A refrigerant.

2.3 DESIGN REQUIREMENTS

A. Provide a complete factory assembled or knocked down water cooled, oil free centrifugal chiller equipped with MagLev® compressors as specified herein. Chiller to be built in accordance to the standards defined in Section 1.02 of this specification.

B. Each chiller shall be equipped with the following: One (1) flooded evaporator heat exchanger, one (1) water cooled condenser heat exchanger, one (1) or more MagLev® Compressors (refer to section 2.03 B) with variable speed drive, soft start, magnetic bearings, and inlet guide vanes or intraflow valve, one (1) or more electronic expansion valves, one (1) liquid level refrigerant sensor monitoring condenser level, one (1) load balance valve per compressor, one (1) master chiller control with necessary operating controls and system safeties.

C. Chiller Performance: Refer to performance schedule on the job specific drawings.

D. Unloading: The compressor shall be capable of unloading to 15 tons. When using a MagLev® TT-350, compressor shall be capable of unloading to 25 tons. All unloaded capacity values are without the use of traditional hot gas bypass or load balance valves.

E. Loading: Chiller shall be able to stage compressor(s) without drastically unloading compressors on-line or creating check valve chatter on staged compressors. Total pressure ratio shall not be decreased below 2.4 pressure ratio as observed at the suction and discharge flanges of each individual compressor when staging lag compressors.

F. Acoustics: Sound data shall be measured in accordance with AHRI 575 Standard. Unit sound performance data shall be measured at the highest level recorded at all load points. Unit sound performance shall not exceed the scheduled level.

G. Electrical: Chiller shall feature single-point power connection not utilizing adjoining power cabinets as pull boxes.

H. Minimum Operating Conditions: Lowest evaporator saturated suction temperature shall not be below 34F. Lowest leaving chilled water temperature shall not be below 38F. Lowest entering condenser water temperature shall not drop below 55F. A differential of 12F between the leaving chilled water temperature and entering condenser water temperature is required to ensure chiller can maintain minimum lift requirements.

I. Unit dimensions cannot exceed 79” long by 83” high and a 26” wide frame.

2.4 CHILLER COMPONENTS

A. Compressors

1. Chiller to have one or more MagLev®, magnetic bearing, oil-free, two- stage, hermetical centrifugal compressor(s). Each compressor to contain integrated (TT only) or remotely mounted (VTT) variable speed drive with soft start, and weigh no more than 300 lbs. Inlet

guide vanes are only permissible when using TT compressors or in combination with a VTT compressor.

2. Each compressor to be microprocessor controlled. Each compressor to be networked to master controller via RS485 at a baud rate of 38,400 bps connection with a refresh rate of 50 microseconds and the micro processor of each compressor to control the variable speed drive and inlet guide vanes or intraflow valve on each compressor to maximize unit efficiency.

3. Each compressor shall be capable of coming to a controlled safe stop in the event of a power outage. Unit shall be capable of auto restart in the event of a power outage, once power has been restored.

4. All compressors are required to be mechanically and electrically isolated to facilitate proper maintenance, service, and or removal.

5. Each compressor shall be equipped with a minimum anti-recycle time of 5 minutes if power electronics are too warm before being allowed to restart.

6. Minimum restart time of a compressor, without a UPS, from power down till drive line is rotating shall not exceed 3 minutes.

B. Refrigerant, Evaporator and Condenser

1. All heat exchangers to be built in accordance to Section VIII of the ASME code and carry a manufacturer's name plate certifying ASME compliance.

2. The evaporator is to be of shell and tube construction. Evaporator to be constructed of a single shell. Evaporator to be of flooded type with refrigerant surrounding the tubes and water passing through the tubes. Tubes to be enhanced and rifled. Minimum tube velocity of two (2) feet per second required. Design to not exceed a maximum tube velocity of nine (9) feet per second. Internal intermediate tube supports, liquid eliminator baffle plate, pressure relief vent, water drains and vents required. Pressure relief to be spring loaded self seating type in accordance to ASHRAE 15 standard. Evaporator to be pressure tested at a test pressure of 1.1 times the operating pressure however no less than 100 PSIG. Evaporator, water boxes, suction piping, and any other component subject to condensate shall be insulated with a UL recognized ¾ inch or 1½" closed cell insulation. All joints and seams to be sealed so a vapor barrier is created. Factory mounted & wired thermal dispersion switch required for flow safety. Evaporator shall be able to hold entire unit charge as required for machine service. Evaporator cable of forty-five (45) percent rate of change per minute on water side and maintain stable operation without dropping compressors offline.

3. The condenser to be of shell and tube construction. Condenser to be constructed of a single shell. Condenser to be water cooled type with refrigerant surrounding the tubes and water passing through the tubes. Tubes to be enhanced and rifled. Minimum tube velocity of two (2) feet per second required. Design to not exceed a maximum tube velocity of nine (9) feet

per second. Internal intermediate tube supports, pressure relief tree with isolation valves, water drain and vents required. Pressure relief tree to be equipped with isolation/transfer valve to prevent the loss of refrigerant when relief is removed for testing and or replacement. Rupture disks are not acceptable. Condenser to be pressure tested at a test pressure of 1.1 times the operating pressure however no less than 100 PSIG. Factory mounted & wired thermal dispersion switch required for flow safety. Condenser shall be able to hold entire unit charge as required for machine service. Condenser shall be cable of forty five (45) percent rate of change per minute on water side and maintain stable operation without dropping compressors offline. Condenser heads and tube sheets shall be epoxy coated to prevent corrosion.

4. Heat Exchangers to feature enhanced and rifled individual tubes. Tubes shall be individually replaceable. Tubes shall be mechanically rolled into steel tube sheets and sealed with Loctite® or equivalent sealant. Tubes shall be supported by intermediate tube supports at a maximum spacing of 18" apart. Waterside to be designed to a minimum of 150 psig, 300 psig or 450 psig, whichever is specified. Heat exchangers to be equipped with either dished heads or marine boxes with drain and vent reports, whichever is specified. Piping connections to be either mechanical grooved connection or flange, whichever is specified.

5. Refrigerant Control: Chiller to feature a minimum of one (1) electronic expansion valves with a step count of 480 steps to full open and a fully closed transit time of less than ten (10) seconds to prevent refrigerant migration. Additional valves to be added as chiller capacity dictates. Fixed orifices and float controls are not acceptable. The electronic expansion valve to operate from minimum chiller capacity to the full load of the chiller's capacity. A high side refrigerant level sensor, with sight glass is to be used to provide feedback to the expansion valves for proper control. This ensures that a proper liquid seal is always present on the compressors power electronics. A refrigerant sight glass is required on the main liquid line feeding the electronic expansion valves. Isolation valves required to isolate charge in either the condenser or evaporator.

C. Prime Mover:

1. The prime mover shall be of sufficient size to effectively meet the compressor horsepower requirements. Prime mover shall be a one or more liquid refrigerant cooled, hermetically sealed, permanent magnet synchronous motor. Motor shall be controlled by variable speed drive. Motor shall utilize soft start capabilities with an inrush current no greater than two (2) amps. Motor shall have internal thermal overload protection devices embedded in the winding of each phase of the motor.

D. Variable Speed Drive:

1. The chiller shall be equipped with multiple variable speed drives unless one compressor is used. Please refer to section 2.03 B for compressor requirements. The variable speed drive to utilize Insulated Gate Bi-Polar Transistors (IGBT). Variable speed drive to create its own simulated AC voltage for the motor connected to it. Acceptable applied voltages are: 400

Volt 50 hertz, 460 Volt 60 hertz, and 575 volt 60 hertz. 575 volt applicable to TT-300 and TT-400 only.

2. Variable Speed drive shall be controlled via compressor microprocessor to optimally match the lift and load requirements. Any remotely mounted drive shall be manufactured by the same company as the compressor and shall be both refrigerant and air cooled. Air cooled alone is not acceptable.

3. Each TT compressor with integrated drive is required to have a line reactor and circuit breaker. No line reactors are required for VTT

E. Chiller Controls

1. The unit shall have an industrial grade CPU with an ARM Cortex A-8 processor FlexSysTM Controller. All chiller and compressor I/O to be controlled via 10/100 Ethernet (2), RS-485 (2), and USB (2). Controller to have 18.5 inch TFT touch screen interface that can be disconnected and chillers still runs properly.

2. Controller to use natural progression control algorithms which properly define the compressors operating range to optimize loading, unloading, and control of multiple MagLev compressors. User shall operate chiller via HMI located on touch screen or remote web connection. All system parameters, compressor status, alarms, and faults, trend graphing, fault logging, bas communication window, logbook, and control set points shall be viewable. Shall be able to fully commission and adjust all components on the chiller, including the compressors without an auxiliary computer or software.

3. The chiller controller shall include the necessary I/O for proper chiller operation including:

4. Hardware

   a. Dedicated EXV Output for each liquid level EXV and/or Economizer Valve Chiller LP Safety input

   b. Chiller HP Safety input Chilled Water Safety input Condenser Water Safety input E-Stop input

   c. Chilled Water Reset input Load Limit input

   d. Tower Setpoint output Chiller kW output Chiller Amps output

   e. Condenser Water Bypass Valve output Chiller Run Contact output

   f. Chiller Fault output

   g. Compressor Lockout Fault Status output

   h. Dedicated Compressor Enable output (no relay or paralleled signal) Dedicated Economizer Enable output (no relay or paralleled signal) Chilled Water In and Out Temperatures

i. Condenser Water In and Out Temperatures Liquid Line Temperature(s)

j. Standard pump and tower control

k. Single CHW and CW pump enable standard

l. Tower fan enable with speed output standard

m. Dedicated RS-485 communication to each compressor Dedicated RS-232 communication to each compressor

n. Linux based operating system with embedded PC utilizing Windows. DC Powered to ensure maximum resistance to EMI and RFI noise

o. Built in 2-port Ethernet Switch for easy integration to BAS interface and web control feature.

p. On board USB drives to support external peripheral devices including keyboard, mouse, and printer

q. 18.5 “TFT display featuring 1024 X 768 Resolution. All hardware, including I/O is CE and UL Certified

r. All wiring utilizes spring capture technology to prevent loose connections or wires from falling out.

s. RS-485 communication at baud rate of 38,400 bps

t. Optional auxiliary device expansion hub for control additional pumps, towers, etc

F. Software

1. Can control one (1) to five (5) compressors on single or multiple refrigerant circuits

2. Control System can control up to six (6) exv’s with proper hardware and network all exv’s to the control system

3. Controls shall have the capability of controlling different size and model compressors for maximum efficiency and turn down

4. HMI interface allows the user the following options: definable points list, tag names, and functions without special software. With this feature, end user can scale an all inputs and outputs, change what controls it, change the functionality, the name of it etc.

5. Chiller controller has the Danfoss Turbocor Compressor Software on board. This allows for no laptops for a service tech in additional to advanced remote troubleshooting.

6. Control System features easy to use web interface. This allows the user to do anything remotely that could be done in front of the chiller/

7. Over 200 data points are recorded in five (5) second intervals. Data can be analyzed with zoom feature. Data stored on separate 32 GB drive. Trend graph images can be exported. Trend graphs can be exported to csv files as well.

8. Advanced Fault Logging featuring calendar capability for ease of use. Data can be sorted by alarm type, time stamp, or compressor.

    a. Color coded data. Green data means good, yellow means alarm, red means fault or off

    b. Controller logs when user makes any type of change

    c. Controller has onboard maintenance log to store system information Controller offers real time capacity and efficiency data

9. BAS Interfaces include:

    a. Modbus RTU standard

    b. Modbus TCP/IP standard

    c. BAC Net TCP/IP (optional)

    d. BACNET MSTP (optional)

    e. Lonworks (optional)

10. BAS interface dashboard shown on HMI. This allows the user to view what data is being written to the BAS system. Also shows if there is an error, last com, and how many times the data was sent or received.

11. Control system uses proprietary natural progression control algorithms to perform accurate energy balance on all systems for maximum system performance.

12. Control System features an optimum start function to ensure initial lift is always made. This prevents nuisance check valve flutter and compressor faults.

2.5 OPTIONS

A. Heat Exchangers:

    1. 4 pass configurations to meet water side design criteria

    2. 60“ Heat exchanger lengths

B. Controls: BACNET MSTP – confirm with ATC prior to ordering

C. 4 Pass Evaporator

D. 4 Pass Condenser

E. 3/4" Closed Cell Foam Insulation (Evaporator)

F. Refrigerant (513-A)

G. Evaporator OGS Groove Coupling

H. Condenser OGS Groove Coupling

I. 25kA SCCR

PART 3 EXECUTION

3.1 INSTALLATION

A. Chiller must be installed per all of the manufacturer's documentation. This includes IOM Manual, Submittal documentation, CAD Drawings, other.

B. All local structural codes must be observed. Chiller to mounted and aligned on chiller pad or mounting rails as specified on CAD drawings.

C. All local plumbing codes must be observed. Piping must be run in such a way that the proper required clearances for head removal for tube cleaning are observed.

D. All National and Local Electrical codes must be observed. Instillation of the electrical on the chiller must follow the associated documentation from the chiller manufacturer. Electrical installation shall be coordinated with electrical contractor.

E. All National and Local Electrical codes must be observed. Controls installation shall be coordinated with the controls contractor.

F. Provide all material required for a fully operational and functional chiller.

G. Assemble chiller per IOM Manual.

3.2 START-UP

A. Units shall be factory charged with R-513A refrigerant unless unit is knocked down.

B. Factory Start-Up Services: An authorized factory start agent is required. At minimum, (2) two days shall be spent on-site to ensure proper unit operation.

C. The start-up technician is to utilize the factory run report to ensure the equipment is operating at the tested performance levels when shipped from the factory.

D. During the start-up period, the factory authorized agent will instruct the owner's representative and the contractor on proper care and operation of the chiller.

END OF SECTION