SECTION 23 0500
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 STIPULATIONS

1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections, apply to this Section.

1.2 EXECUTION OF THE WORK

1. These specifications call out certain duties of the HVAC Contractor and any Subcontractors. They are not intended as a material list of items required by the Contract. Any reference in these specifications and on the accompanying drawings to the Contractor, Mechanical Contractor, ATC Contractor, Mechanical HVAC Subcontractor, Subcontractor or abbreviation "M.C.", shall be construed to mean the Contractor responsible for all mechanical construction (Division 23) work for this project.

2. This division of the specifications covers the HVAC systems of the project. It includes work performed by the mechanical trades as well as trades not normally considered as mechanical trades.

3. Provide all items and work indicated on the Drawings and all items and work called for in this division of the specifications in accordance with the conditions of Contract (Division 01 General Requirements Documents). This includes all incidentals, equipment, appliances services, hoisting, scaffolding, supports, tools supervision, labor consumable items, fees licenses, etc., necessary to provide complete systems. Perform start-up and checkout on each item and system to provide fully operable systems.

4. Comply with all provisions of the Contract Documents including the General Conditions, and Division 01 General Requirements of the specifications.

5. Certain terms such as "shall, provide, install, complete, start-up" are not used in some parts of these specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

6. Examine and compare the HVAC Drawings with these specifications and report any discrepancies between them to the Architect/Engineer and obtain from him written instructions for changes necessary in the work. At time of bid the most stringent requirements must be included in said bid.

7. Examine and compare the HVAC Drawings and Specifications with the Drawings and Specifications of other trades, and report any discrepancies between them to the

    a. Architect/Engineer and obtain from him written instructions for changes necessary in the work.
    b. At time of bid, the most stringent requirements must be included in said bid.

8. Install and coordinate the HVAC work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor, caused by his neglect to do so, shall be made by him at his own expense.

9. It is the intent of the Drawings and Specifications to provide a complete code compliant workable system ready for the Owner’s operation. Any item not specifically shown on the Drawings or called for in the Specifications, but normally required to conform with the intent, are to be considered a part of the Contract.

10. These specifications are basically equipment, installation, and performance Specifications. Some installation details are indicated on the Drawings. Where these differ from the Specifications, apply the more stringent at time of bid. Upon award of bid, contact Architect/Engineer for definite instructions.

11. All materials furnished by the Contractor shall be new and unused (temporary services are excluded) and free from defects.

12. All products and materials shall be new, clean, free of defects and free of damage and corrosion.

13. The exclusion from, or limitation in, the symbolism used on the Drawings or the language used in the Specifications for HVAC work shall not be interpreted as a reason for omitting the accessories necessary to complete any required system or item of equipment.

14. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.

15. All items of equipment or material shall be the product of one manufacturer throughout. Multiple manufacturers will not be permitted.

16. Receive, inspect, store and install Owner-furnished equipment where Owner furnished equipment is supplied.

1.3 COORDINATION OF THE WORK

1. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.

2. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.

3. No items foreign to the electrical system shall be run in the dedicated space of the electrical equipment. Dedicated space shall be defined as the width and depth of the equipment from the floor to the bottom of the structural ceiling. Foreign systems include but are not limited to piping, sprinklers, drip trays, etc. Contractor shall be responsible to coordinate the locations of the dedicated spaces with electrical and other trades as required.

4. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.

5. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.

6. Due to the type of installation, a fixed sequence of operation is required to properly install the complete systems. Coordinate, project, and schedule work with other trades in accordance with the construction sequence.

7. The locations of piping, control panels, and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

8. The Drawings show only the general run of piping and approximate location of termination. Any significant changes in location of routing, necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.

9. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.

10. Contractor shall furnish services of an experienced Superintendent, who shall be in constant charge of all work, and who shall coordinate his work with the work of other trades. No work shall be installed before coordinating with other trades.

11. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.

12. Where service connections are required, to equipment provided by the Owner or by other trades, this Contractor shall verify the exact requirements for these connections prior to ordering any materials or laying out any work. Where there is a discrepancy between the equipment being furnished and that shown on the Contract Drawings, the Contractor shall notify the Architect/Engineer for direction. Failure to comply with this coordination shall not constitute a reason for extra monies for equipment ordered or installed. Restocking charges will not be paid.

1.4 RELATED DOCUMENTS

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

1.5 SUMMARY

1. This section includes the general requirements that apply to the Mechanical and HVAC Contractor. Fire Protection and the Controls Contractor or Sub-Contractor.

2. The following work is specified under other Divisions, unless otherwise noted or specified hereinafter:

    a. Site Work, Divisions 31, 32 and 33.
    b. Concrete, Division 03.
    c. Mechanical, Division 23.
    d. Electrical, Division 26.
    e. Installation of starters, contactors, thermal overload switches and remote push buttons, and connection of power wiring to motors, Division 26.

1.6 INTENT

1. Requirements specified herein shall govern applicable portions of Heating, Ventilation and Air Conditioning.

2. It is the intent of this specification and accompanying drawings to describe and indicate the general manufacture, erection and installation of the equipment and connection to 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 satisfactory installation and are considered to be the accepted practice of the trade, they shall be considered to be both specified and indicated. Drawings are diagrammatic in nature; for piping systems; water piping is tapped off the bottom of the pipe and steam and steam condensate piping is tapped off the top of the pipe; provide all tees, elbows and swing joints as required for hookup to coils or branch piping as required for this work whether they are indicated on the drawings or not.

3. It shall be understood that the Contractor as hereinafter mentioned shall be the Mechanical Contractor unless specifically noted otherwise.

4. The Contractor shall furnish all plant, labor and material necessary for the complete and satisfactory installation of all Mechanical work for this contract.

5. The Contractor shall assume the entire responsibility for the materials, workmanship and satisfactory operation of the various mechanical systems, and other work as specified herein and/or as shown on the drawings.

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

1.7 DEFINITIONS

1. Following definition of terms and expressions used in this section are in addition to listing given in Supplementary Conditions:

    a. "Provide" shall mean "furnish and install" unless otherwise indicated.
    b. "Herein" shall mean the contents of a particular section where this term appears.
    c. "Indicated" shall mean "Indicated on contract drawings".
    d. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
    e. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
    f. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
    g. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
    h. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
    i. The following are industry abbreviations for plastic materials:

        1. ABS: Acrylonitrile-butadiene-styrene plastic
        2. CPVC: Chlorinated polyvinyl chloride plastic
        3. NP: Nylon plastic
        4. PE: Polyethylene plastic
        5. PVC: Polyvinyl chloride plastic

1.8 CONTRACTOR'S RESPONSIBILITY

1. The Contractor shall be responsible for establishing grades and elevations, and checking of all interferences, and shall verify all dimensions and locations in the field.

2. Contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, ducts, piping and approximate sizes and locations of equipment outlets. Mechanical trades shall follow these drawings in layout of their work, consult general construction, structural and electrical drawings to familiarize themselves with all conditions affecting their work, and shall verify spaces in which their work will be installed.

3. The Contractor shall verify with the A/E before bidding any item of piping or piping arrangement which may be incomplete, incorrect or indefinite. After contract is let, the A/E's decision shall be final.

4. All trades shall cooperate and confer with each other as to locations of their materials and equipment before erecting work, so as to avoid interference as much as possible, and in such a manner that will in no way retard progress of construction. In instances where interferences develop, the contractor shall relocate the work as required by the A/E regardless of which work was installed first.

5. Where job conditions require reasonable changes to indicate locations and arrangement, make such changes without extra cost to Owner. This is not to be construed to permit redesigning of the various systems.

6. Additional and supplementary drawings may, from time to time, be furnished, and the same, when made, are to constitute a part of the original contract. These drawings will be made to clarify the contract drawings and will not depart materially therefrom.

7. The A/E specifically reserves the right, up to the time of roughing-in, to exactly define the position of the equipment to be installed and connected to an arrangement of these connections.

8. Special attention is called to the contract drawings and specifications involving general construction, electrical work and details thereon. Bidders are notified to carefully scrutinize these documents for the details affecting the performance of the mechanical trades.

1.9 SCHEDULE OF WORK

1. The Contractor shall schedule all of his work to conform to the Job Progress Schedule as submitted by the General Contractor or Construction Manager and approved by the A/E and school district.

1.10 PREMIUM TIME WORK

1. The following work shall be performed at night or weekends other than holiday weekends, as directed and coordinated with the Owner:

    a. Tie connections to all existing systems.

1.11 PROGRESS OF WORK

1. The Contractor shall order the progress of his work so as to conform to the progress of the work of other trades and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from the defective or ill-timed work performed under this section shall be borne by the Contractor.

1.12 DELIVERY, STORAGE, PROTECTION AND HANDLING

1. Deliver, store, protect and handle all products and materials in a manner which will protect them from damage, weather, and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair. Any such repairs shall be subject to review and acceptance of the Architect/Engineer.

2. Delivery of Materials: Delivery materials in manufacturer's unopened container fully identified with manufacturer's name, trade name, type, class, grade, size and color.

3. Storage of Materials, Equipment and Fixtures: Store materials suitably sheltered from the elements, but readily accessible for inspection by the Architect/Engineer until installed. Store all items, susceptible to moisture damage, in dry, heated spaces.

4. Protect materials and equipment according to the manufacturer's instruction. Protection shall include damage due to fire, water, rust, oxidation, sunlight (for UV sensitive materials), breakage of UV lights, etc.

5. Following is in addition to Protection of Work and Property, General Requirements:

    a. Responsibility for care and protection of mechanical work rests with the Contractor until it has been tested and accepted.
    b. After delivery, before, during and after installation, protect equipment and materials against theft, injury, and damage from all causes.
    c. Protective covers, skids, plugs, caps, and coating shall be provided to protect equipment materials from damage during construction.
    d. All equipment and material shall be stored under cover and off the ground.
    e. For outdoor storage, protective covers of sheet plastic shall be provided. Covers shall be of gauge required for the area involved and shall be reinforced to withstand wind, rain, sleet, and snow. Equipment and material shall be set on skids or platforms of sufficient height to avoid deterioration from spattering and ground water.
    f. Plug open ends of pipes when work is stopped to prevent debris from entering the pipes.
    g. Coat polished or plated metal parts with Vaseline immediately after installation.

6. The Contractor shall receive, properly house, handle, hoist, and deliver to proper location, equipment and other materials required for the contract.

7. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect/Engineer and at no additional cost to the Owner.

1.13 INTERFERENCE WITH THE OWNER'S NORMAL OPERATION

1. All work shall be performed in such a manner as not to interfere with the normal work operations in adjacent spaces or buildings.

2. In no way shall the Contractor:

    a. Block or restrict the means of egress for adjacent spaces.
    b. Decrease the fire rating of walls, partitions, ceilings, doors or combination thereof of adjacent spaces or of means of egress.
    c. Interrupt safety systems or in any way adversely affect the safety of people or materials in adjacent spaces.

3. The Contractor shall provide acoustical isolation of the work area via temporary doors, partitions, etc., adequate to allow normal work functions.

4. The Contractor shall provide exhaust fans, dust proof temporary partitions and any containment measure required to prevent dirt, dust, or fumes from reaching adjacent workspaces.

5. All personal traffic and material delivery shall be routed to absolutely minimize travel through adjacent work area.

1.14 VISIT TO SITE

1. The Contractor shall visit the site and thoroughly acquaint himself with all existing conditions relative to type and source of service available. He shall verify location and extent of these services and consider routing, interferences and excavation required by the contract and all other difficulties that may be encountered.

2. Submission of a proposal shall be construed as evidence that such an examination has been made.

3. Failure to visit the site shall not constitute sufficient reason to warrant claims for extra monies for difficulties not apparent in the contract documents.

1.15 MANNING THE PROJECT

1. The Contractor shall, upon initiation of construction, keep a suitable force of men on the site at all times in order to lace all sleeves, inserts, outlet boxes, fixtures and provide all other openings as are required for the satisfactory installation of equipment.

1.16 FEES AND PERMITS

1. The Contractor shall secure all permits and pay all fees, required by local and state governing bodies, necessary to complete his phase of the construction. Failure to investigate all applicable payments before the bid submission shall not constitute grounds for additional monies from the Owner. The Owner shall be furnished with all certificates of approval.

2. The Contractor shall provide insurance and bonding as required by the Building Owner or as stated in the General Conditions.

1.17 CODES AND STANDARDS

1. The design, construction and installation of all materials and equipment shall be in compliance with the latest edition of all national, state and local codes or standards.

2. The codes and standards referred to are minimum standards. Where the requirements of these specifications and the accompanying drawings exceed those of the codes and standards, the drawings and specifications shall be followed.

1.18 BASIS OF DESIGN

1. The layout is based upon the use of particular items of equipment, identified by manufacturer's make and model number. Dimensions, arrangements and service connections required for these particular items have been considered in making the layout. The contractor may use the equipment of any manufacturer whose name is approved for substitution on that item of equipment after he had ascertained that all provisions of MATERIAL SUBSTITUTIONS will be complied with and that all required service connections will be made at no additional cost to the Owner.

2. Manufacturers are listed for a quality assurance level only. Although a manufacturer is listed does not constitute compliance with the specification size, weight, functionality, capacity, noise, or performance levels. It is this contractor's responsibility to assure the proposed manufacturer has complete compliance with the Contract Documents, **prior to bidding**.

3. Except where dimensions are shown, the drawings are diagrammatic and shall not be scaled. Exact location of fixtures, apparatus, duct work and piping shall be determined by dimensions on the site. Contractor shall refer to architectural plans and details for exact dimensions.

4. The drawings indicate the locations of apparatus and piping shall be followed as closely as possible. If before the installation it is found necessary to change the location to accommodate conditions at the building, such changes shall be made at no additional cost to the Owner, and as approved by the Architect/Engineer.

5. Equipment requiring operation, service, or maintenance during the life of the system shall be made easily accessible.

6. Ductwork or piping shall not be run within 48" of switchboards, panelboards or motor control centers.

7. No piping to other HVAC items shall be run in the dedicated equipment space as defined in the N.E.C. (NFPA 70). The dedicated equipment space is the space equal to the width and depth of the equipment and extending from the floor to a height of 6ft. Refer to the National Electrical Code section 11 0. 26 (E) for further information. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in this zone. It is this contractor's responsibility to coordinate with the electrical contractor for all phases of this project.

8. Use of open-flame devices in work shall be accompanied by fire extinguishing apparatus within 25 feet of work location. All work shall be done in accordance with the general construction requirements and fire watch procedures.

1.19 QUALITY OF MATERIALS

1. Where a specific model and manufacturer of equipment is specified, the Contractor shall provide what is specified without substitution. Where specified as "or approved equal", the Contractor may substitute equipment except that the burden is upon the Bidder to prove such equality. If the Bidder elects to prove such equality, he must request the Architect's approval in writing to substitute such item for the specified item, stating the cost difference involved with supporting data, and samples, if required, to permit a fair evaluation of the proposed substitute with respect to quality, serviceability, warranty and cost.

2. Where a specific model of equipment is specified along with an approval equal manufacturer, no substitution will be allowed. The Contractor shall submit one of the manufacturers listed.

3. Final approval of competitive equipment is reserved by the Engineer when, in the Engineer's opinion, the equipment does not correspond to that specified.

1.20 MATERIAL SUBSTITUTIONS

1. Material substitutions shall be allowed only where "or equivalent" is stated.

2. Material substitution submittals shall, include complete description of the proposed substitute, the name of the material or equipment for which it is to be substituted, drawings, cuts, performance, test data and evidence that the proposed manufacturer or his established representative maintains a qualified service organization including spare parts and is available for competent service on short notice.

3. Each bidder by submitting his bid represents that the proposal of such article, device, product, material, fixture, form or type of construction by name, make, catalog number of manufacturers which varies with the equipment specified shall be incorporated into the project without claims against the Owner for additional cost. The bidder shall be responsible for all additional costs incurred by others due to the substitutions.

4. The Architect/Engineer shall have the final approval of all submitted substitutions.

5. Manufacturers are listed for a quality assurance level only. Although a manufacturer is listed does not constitute compliance with the specification size, weight, functionality, capacity, noise, or performance levels. It is this contractor's responsibility to assure the proposed manufacturer has complete compliance with the Contract Documents, **prior to bidding**.

1.21 SUBMITTALS

1. Product Data, Shop Drawings: Submit for approval by the authority having jurisdiction and the Owner's insurance underwriter.

2. Product Shop Drawing Submittal List:

a. Within thirty (30) days after date of execution of the Owner/Contractor Agreement, submit for review and acceptance, a list of all material and equipment manufacturers whose products are proposed, as well as names of all subcontractors whom this trade proposes to employ.
b. Any requests for substitutions of equipment or materials must be submitted and returned prior to submitting the Submittal List. Only specified or accepted manufacturers or suppliers shall appear on the Submittal List.
c. The complete Submittal List must be reviewed and accepted by the Architect/Engineer prior to submittal of Shop Drawings. No Shop Drawings will be processed without an accepted Submittal List.
d. The Submittal List shall include all material, systems, and equipment specified herein.

3. Approval shall 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.

4. All submittals shall bear a stamp or notation indicating that the Contractor has reviewed and approved the submittals.

5. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and shall clearly identify equipment being submitted.

6. Submittals shall be marked to show specification reference including the section and paragraph numbers.

7. Submit each section separately and include the following:

a. 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.

b. Submittals on all pumps and fans shall be complete with performance curves marked with the design points.

c. Submittals on electrical equipment shall be complete with all power and control wiring diagrams.

d. Vibration isolators shall include operating weight and load distribution at each mounting point.

8. The Contractor agrees that failure of manufacturer's submittal to conform to the above will result in a manufacturer's disqualification on this project.

9. Submit samples as directed of items called for in the specifications; samples of the materials which the manufacturer will actually ship shall be submitted for approval after award of contract and properly labeled on this project.

1.22 ELECTRICAL

1. Power Wiring

a. For the purpose of this specification, power wiring shall be defined as follows:

i. All wiring from the power source panelboards (or switchboard) to the disconnect switch to the equipment, and final connection to the equipment.
ii. All wiring to control panels as indicated in the Electrical and Mechanical Contract Documents. (All control panels not indicated on the Electrical Contract Documents as receiving power shall do so by jumpers from other control panels, this wiring shall be considered control wiring as defined below).

b. All power wiring from the power source to the above noted switches and wiring from these switches to the equipment, including final connection to same, shall be provided under Division 26, Electrical.

2. Control Wiring

   a. All other wiring required, whether line voltage or low voltage, internal or external to provide for the operation of the equipment shall be considered as control wiring. This shall include power wiring from transformers serving dampers at exhaust fans; wire to damper and fan end switch to starter.
   b. All control wiring throughout the building, including wiring installed at piping, in ductwork, or as specified shall be provided under this Division.

3. The Contractor shall furnish all motors, mounts, motor starters and remote mounted push-button controls for all electrically operated equipment furnished as part of the contract. The Contractor shall furnish all safety disconnects. The Contractor shall furnish all speed control switches for all multi-speed motors. All motors shall have copper windings. (Aluminum windings will not be acceptable).

4. This Contractor is completely responsible for the coordination with all other trades as to the correct voltage for all equipment requiring power. Equipment and or changes required to meet the project voltages will be the responsibility of this contractor.

5. All push-button switches and starters shall be mounted under Division 26, Electrical.

6. The Contractor shall provide all controls and control devices, all mounting for controls and all other electrical devices as specified and necessary for the complete installation and satisfactory operation of all electrically operated controls furnished under this Division.

7. All locally mounted starters shall be furnished under Division 23, except as noted below. Where indicated hereinafter, starters shall be furnished as an integral part of equipment. Starters furnished in motor control centers shall be provided in Division 26, Electrical (refer to Electrical Drawings). Control of starters in motor control centers feeding mechanical equipment shall be provided under Division 23.

8. Starting equipment of each motor shall be of the proper voltage and HP rated for the motor it is to serve. All starters shall be of the enclosed type; NEMA Type 1, for general-purpose enclosures; NEMA Type 4 for watertight enclosures, and NEMA Type 12 for the dust-tight enclosures. Location of motor shall determine type of enclosure to be used.

9. Manual motor starters for single-phase motors shall be one or two poles as required, consisting of a snap switch combined with a thermal overload device. It shall be impossible for the switch to be held in a closed position under a sustained motor overload. For resetting the overload mechanism, the switch lever shall be of a design where it has to be moved to the "off" position. Starter shall be enclosed in type of enclosure for area in which it is to be used.

10. Magnetic starters for 3-phase motors shall be furnished with 110 volt holding coils, 120 volt fused transformers, normally open and normally closed auxiliary contact and overload relay heater elements in all three phases. Provide hand/off/auto selector switch along with running status lights and external reset button.

11. Locate starters and associated starter controls in accessible locations wherever possible. Location of starters for roof mounted exhaust fans and mechanical equipment above ceilings shall be located at accessible locations above ceiling. Locations shall be coordinated with furniture and equipment layouts for the optimum accessible location for installation and maintenance means.

12. The Contractor shall be completely responsible for the coordination of automatic temperature control system with control interlocks between various items of mechanical equipment.

1.23 SCAFFOLDING

1. The Contractor shall furnish and install scaffolding, ladders and runways required in connection with his work.

1.24 TEMPORARY OPENINGS

1. Temporary openings not indicated, which may be required for purpose of bringing equipment into building, shall be as approved. General Contractor will perform work of providing and maintaining openings, and of restoring structure; but Contractor for whom temporary openings are provided shall bear costs thereof, and for restoring structure. Ample notice shall be given of size and location of such openings by Contractor requiring same.

2. Holes provided in General Construction work to permit installation of lines for temporary mechanical services will, after removal of such lines, be patched as specified under Division 01.

1.25 CUTTING AND PATCHING

1. The Contractor shall provide all floor and wall cuts as required for ductwork and piping penetrations of existing construction.

2. No cutting of bearing walls, beams, etc., shall be done without the approval of the Architect. All patching and finishing, etc., shall match the surroundings. All cutting and patching shall be done by workmen skilled in the trades and in the employ of the General Contractor for the project. All cutting shall be done with saw type edges to give a neat and workmanlike appearance. All pipe holes shall be core drilled unless specified otherwise.

3. Should it be necessary to do any cutting and patching due to the failure of this Contractor to give proper information to the General Contractor, it shall be done at the expense of the Mechanical Contractor.

1.26 PAINTING AND FINISHING

1. Except as specified herein, the finished painting of Mechanical Work within the building and on the roof shall be as specified under Division 09.

2. All mechanical equipment shall have a factory-applied prime and finish coat of paint. Galvanized surfaces shall be considered as finished surfaces for equipment rooms and items concealed from view. Plastic products shall be acceptable without a finish coat of paint. All items of equipment marred or rusted, even though factory finished, shall be repainted; steel angles and steel supports for ductwork, piping or miscellaneous equipment shall have a prime coat of paint before installation.

3. General Contractor to paint all exposed piping, equipment, and trim that does not have a factory applied finish. Refer to Division 09 "Painting" for paint materials, surface preparation and application of paint. Paint shall be semi-gloss, acrylic-enamel paint. Coat components with two (2) coats of finish paint over two (2) coats of rust inhibitive metal primer or approved equivalent based on component type.

1.27 CONCRETE WORK

1. Concrete work shall be in accordance with Division 03.

1.28 SUSPENSION SUPPORT FOR PIPES & EQUIPMENT

1. All pipes and equipment that are suspended shall be connected directly to the building steel. Where hangers are required between building steel points, supplementary steel members shall be added by the Contractor as required to adequately support the load.

2. Pipes shall not be supported from other pipes, ducts, or equipment.

3. Hangers from joists shall be attached at the panel points. Pipes 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).

1.29 ACCESS PANELS – BUILDING

1. Access plates and valves located concealed in walls or above ceilings and are otherwise inaccessible shall be furnished with an access panel for each location. A hinged inconspicuous type access panel complete with frame, of such size and so located as to provide proper access for service and maintenance.

2. The minimum size of each access panel shall be 18” x 18” unless physical restraints require a smaller door.

3. Panels shall be furnished under this Division and installed under another Division of the Specification.

4. When access panels or doors are installed in fire rated construction, they shall be fire rated to match the construction.

1.30 FIRESTOP PENETRATION PROTECTION SEALING SYSTEM

1. Where pipes pass through fire partitions, firewalls, floors or ceilings, install a firestop that provides an effective barrier against the spread of fire, smoke, gases and water. Fire-stop material shall be packed tight, and completely fill clearances between pipe, sleeves and structure. All crack voids or holes (up to 4" diameter) shall be sealed using 3M brand Fire Barrier Caulk CP25 or putty 303 or an approved equal. Larger diameter or square holes, 3M system 7902, 7904, 7902R or 7904R or approved equal shall be in accordance with manufacturer's instructions.

2. Fire-stopping material shall maintain its integrity while preventing the passage of flame, smoke, gases or water. Fire-stopping material shall be a one-part, intumescent elastomer noncombustible, noncorrosive and compatible with synthetic cable jackets as defined by ASTM E814 (UL 1479); and in addition, for insulation materials, melting points shall be a minimum of 1700 degrees F for one-hour protection and 1850 degrees F for 2-hour protection.

1.31 RECORD DRAWINGS

1. The Contractor shall furnish record as-built drawings to the Architect at completion and acceptance of the job. Transparencies of the original drawings with corrections shall be submitted as specified in the General Requirements.

2. Record all changes from installation originally indicated. Record final location of underground lines by depth from finished grade and by offset distances in feel and tenths to surface improvement such as buildings, curb, or edges of walks. Where work appears on two or more drawings, Contractor shall mark changes on all drawings. Contractor shall mark changes on all drawings. At completion, furnish the above required transparencies to the A/E for approval and record. Drawings shall be certified to be record of work installed and signed by the Contractor. Work shall not be accepted until such drawings have been delivered to the A/E.

1.32 GUARANTEE

1. In addition to the requirements stated in the specifications, the Contractor must guarantee all equipment, materials, and appurtenances installed by him to be free from all defects for a period of one year from date of final acceptance.

2. Upon written notice from the A/E, the Contractor shall promptly correct all defects without additional cost to the Owner. This Contractor shall adjust each part of the entire installation for proper working order. Reports are to be submitted to the A/E and adjustments repeated until the entire system is satisfactory. This Contractor must make good at his own expense, any defects in materials or workmanship that may appear.

1.33 CLEAN UP

1. The Contractor shall be held responsible for the general clean up of all areas affected by the work in the Contract. All rubbish and accumulative material shall be removed from the premises and the premises left "broom clean" upon completion.

2. All stickers, rust, stains, labels and temporary covers shall be removed before final acceptance.

3. Foreign matter shall be blown, vacuumed or flushed out of piping, pumps, fans, motors, devices, switches, panels, duct work and equipment.

4. Identification plates on equipment shall be free of excess paint and shall be polished.

1.34 OPERATION AND MAINTENANCE MANUALS

1. Submit to the Engineer for approval three manuals covering details of operation maintenance for all apparatus requiring service. The Contractor shall arrange formal instruction sessions by competent representatives of the manufacturer for the Owner's operating personnel to cover the following:

   a. Service telephone number, fax number, websites, email addresses, business and service addresses and mobile telephone numbers of the installing contractor, and manufacturer and supplier and parts counters of pumps, fans, air handling units, condensate return units, chillers, CV boxes, fan coil units and other components comprising the systems.

   b. Manufacturer's operating and maintenance manuals, including detailed parts lists with numbers, power and control wiring diagrams for each piece of equipment and accessory requiring services or maintenance, the guarantee period and the name, address and phone number of the nearest sales and service organization for each item. Both on print and CD’s (min 3 copies) form (PDF/MS Word).

   c. Cross out options that are not used on equipment sheets, highlight options selected.

   d. Step-by-step procedure for starting, stopping, setpoint adjustment, monitoring and alarm enunciation for each system.

   e. Copies of inspection certificates provided by the City, County, State and insurance companies.

   f. Provide separate Operation and Maintenance Manuals covering the FMCS and in compliance with this section.

   g. Routine maintenance procedures and scheduling for all mechanical equipment.

2. Obtain written statements from the Owner's representative acknowledging satisfactory completion of each item of the manuals.

1.35 INSTRUCTION TO OPERATIONAL PERSONNEL

1. Furnish the services of competent instructors to give full instruction to the designated Facilities personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system on the Contract Documents. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

2. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. Provide 4 man-hours of instruction for each: chemical treatment/glycol systems, pumps, exhaust and intake fans, heat exchangers, CV boxes, fan coil units, condensate return units; 8 man-hours for the AH-1 air handling unit and components including the UV system, 24 man hours for the CH-1 chiller; and 40 man hours instruction for the FMCS (operational, maintenance, programming instruction for trend logging and charting, setpoint adjustment schemes, alarm functionality and other routine operational commands/functions) required by the Owner's personnel..

3. Instruction shall cover routine maintenance, control and power wiring diagrams and component analysis, preventative maintenance and scheduling, starting and stopping, alarm resets, trend-logging, setpoint adjustment, emergency and normal shutdown/startup, alarm date stamping and all else required by the Owner for complete usage/maintenance/adjustment of equipment in their intended systems.

4. Obtain written statements from the Owner's representative acknowledging satisfactory completion of each item of instructions.

PART 2 - PRODUCTS

2.1 MECHANICAL SLEEVE SEALS

1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

    a. Acceptable Manufacturers:

        i. Advance Products & Systems, Inc.
        ii. Calpico, Inc.
        iii. Metraflex Co.
        iv. Accepted substitute in accordance with Section 01 60 0.

    b. Sealing Elements: EPDM interlocking inks, shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

    c. Pressure Plates: Carbon steel. Include two for each sealing element.

2. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.2 SLEEVES

1. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

    a. Underdeck Clamp: Clamping ring with set screws.

2.3 ESCUTCHEONS

1. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

2. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

3. One-Piece, Cast-Brass Type: With set screw.

    a. Finish: Polished chrome-plated.

4. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

    a. Finish: Polished chrome-plated.

5. One-Piece, Stamped-Steel Type: With and chrome-plated finish.

6. Split-Plate, Stamped-Steel Type: With hinge and chrome-plated finish.

7. One-Piece, Floor-Plate Type: Cast-iron floor plate.

8. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.4 GROUT

1. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

    a. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

    b. Design Mix: 5000 psi, 28-day compressive strength.

    c. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SITE INSPECTION

1. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

2. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

3. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PROJECT MANAGEMENT AND COORDINATION

1. Coordination: Coordinate construction operations included in different Sections of the Specification to ensure efficient and orderly installation of each part of the work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

    a. Schedule construction operations in sequence required to obtain the best results where installation of one part of the work depends on installation of other components, before or after its own installation.

    b. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.

    c. Make adequate provisions to accommodate items scheduled for later installation.

    d. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

2. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

    a. Prepare similar memoranda for Owner and separate contractors if coordination of their work is required.

3. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the work. Such administrative activities include, but are not limited to, the following:

    a. Preparation of Contractor's Construction Schedule
    b. Preparation of the Schedule of Values
    c. Installation and removal of temporary facilities and controls
    d. Delivery and processing of submittals
    e. Progress meetings
    f. Pre-installation conferences
    g. Project closeout activities
    h. Startup and adjustment of systems
    i. Project closeout activities

4. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

    a. Salvage materials and equipment involved in performance of, but not actually incorporated into the work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

3.3 SUBMITTALS

1. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

    a. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

i. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

ii. Indicate required installation sequenced.

iii. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

b. Number of Copies: Submit three opaque copies of each submittal. Architect, through Construction Manager, will return one copy.

i. Submit five copies where Coordination Drawings are required for operation and maintenance manuals. Architect and Construction Manager will retain two copies; remainder will be returned. Markup and retain one returned copy as a Project Record Drawing.

b. Refer to individual Sections for Coordination Drawing requirements for work in those Sections.

c. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project Site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

d. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

3.4 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

1. General: In addition to Project Superintendent, provide other administrative and supervisory personnel as required for proper performance of the work.

3.5 PROJECT MEETINGS

1. General: Attend meetings and conferences at Project Site, unless otherwise indicated.

2. Preconstruction Conference: Attend a preconstruction conference before starting construction, at a time convenient to Owner, Construction Manager, and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

3. Pre-installation Conferences: Attend a pre-installation conference at Project Site before each construction activity that requires coordination with other construction.

   a. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Construction Manager of scheduled meeting dates.

   b. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

      i. The Contract Documents
      ii. Deliveries
      iii. Review of mockups
      iv. Possible conflicts

v. Time schedules
vi. Manufacturer's written recommendations
vii. Acceptability of substrates
viii. Temporary facilities and controls
ix. Coordination with other work
x. Protection of construction and personnel

c. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

d. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

e. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the work and reconvene the conference at earliest feasible date.

4. Progress Meetings: Attend progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.

a. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the work.

b. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

i. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1. Review schedule for next period.

ii. Review present and future needs of each entity present, including the following:

1. Interface requirements
2. Status of submittals
3. Off-site fabrication
4. Site utilization
5. Hazards and risks
6. Progress cleaning
7. Status of correction of deficient items
8. Requests for interpretations (RFIs)
9. Status of proposal requests
10. Pending changes
11. Status of Change Orders
12. Pending claims and disputes
13. Documentation of information for payment requests

5. Minutes: Record the meeting minutes.

6. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

    a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

3.6 EQUIPMENT LOCATIONS

1. Equipment locations: All mechanical equipment shall be located to provide for manufacturer’s recommended clearances, clearance for routine maintenance, clearance per code requirements and locations/clearances required for removal/replacement in the future.

2. Manufacturer’s recommended clearances shall include space for clearance for pumps (18" minimum around pumps), 30" clearance or complete access door swings, clearances for tube pulls (heat exchangers, etc.); locate piping to be clear of these locations.

3. Provide minimum 36" clearance around heat exchangers and other pressure vessels; note this is a minimum requirement, provide excess wherever possible. Provide minimum 42" clearance from power panels per the latest edition NEC having jurisdiction; include requirements for piping and ductwork at such locations.

4. Locate equipment in mechanical rooms to allow for future removal and replacement. Include heights to overhead piping where applicable. Wherever possible, clearances shall include removal/replacement as a whole entity without knock-down.

5. Locate roof mounted equipment minimum 10’ away from edges of roof. Where equipment is located closer, provide handrail system at roof edge as required per codes having jurisdiction. Maintain clearances from handrail system to power panels.

3.7 ACCEPTANCE TESTING

1. An acceptance test of the HVAC system shall be performed by the Contractor in the presence of the Owner's representative and the Local Fire Marshal. Upon completion of the successful test, the Contractor shall so certify in writing to the Owner and General Contractor.

2. The Contractor shall also utilize all sub-contractors such as balancing, piping, controls and commissioning agent, and other contractors such as electrical, plumbing, fire alarm and communications as required to perform this acceptance test.

3. The acceptance test shall be performed to determine that the protective measures required as outlined in NFPA 90A and shall function when needed in order to restrict the spread of fire and smoke.

4. The acceptance test shall include testing the HVAC system to determine its full function ability and in compliance with NFPA 90A and the sequence of operation. All controls and equipment shall be modulated throughout their entire ranges and adjustments shall be made for optimum performance.

    a. Portions of control or alarm systems are permitted to have standby power or other emergency modes of operation.

    b. The tests shall be performed to determine that the system operates under the standby power or emergency operation mode as well as under normal conditions.

3.8 CONNECTION TO EXISTING UTILITIES

1. If connecting to an existing piping system (water, gas, steam, condensate, etc.). It shall be the responsibility of this contractor to verify the integrity of the existing piping system being connected. All applicable testing and acceptance will apply.

2. Existing Pipe Testing: The contractor shall remove a section of piping at the point of connection between new and existing. The contractor shall determine the integrity of the existing piping after analysis of the piping section for tube wall thickness, scaling and corrosion. The analysis shall determine the ability for tie-in, pressure testing ability and remaining useful life. The contractor shall guarantee the piping integrity at the point of tie-in and subsequent acceptance. For existing piping not currently being used; the contractor shall pressure test in order to determine integrity and subsequent acceptance. Report all results in writing to the Architect/Engineer.

3.9 PIPING SYSTEMS – COMMON REQUIREMENTS

1. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

   a. New Piping:

      i. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern type.

      ii. Chrome Plated Piping: One piece, cast brass type with polished chrome plated finish.

      iii. Insulated Piping: One piece, stamped steel type with spring clips.

      iv. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass type with polished chrome plated finish.

      v. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped steel type.

      vi. Bare Piping at Ceiling Penetrations in Finished Spaces: Cast brass type with polished chrome plated finish.

      vii. Bare Piping at Ceiling Penetrations in Finished Spaces: Set screw.

      viii. Bare Piping in Unfinished Service Spaces: One piece, cast brass type with finish.

      ix. Bare Piping in Unfinished Service Spaces: One piece, stamped steel type with hinge.

      x. Bare Piping in Equipment Rooms: One piece, cast brass type.

      xi. Bare Piping in Equipment Rooms: One-piece, stamped steel type.

      xii. Bare Piping at Floor Penetrations in Equipment Rooms: One piece, floor plate type.

   b. Existing Piping: Use the following:

      i. Chrome Plated Piping: Split casting, cast brass type with chrome plated finish.

      ii. Insulated Piping: Split plate, stamped steel type with hinge and spring clips.

      iii. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast brass type with chrome plated finish.

iv. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel type with concealed hinge and spring clips.

v. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass type with chrome plated finish.

vi. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel type with concealed hinge and set screw.

vii. Bare Piping in Unfinished Service Spaces: Split casting, cast brass type with finish.

viii. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel type with hinge and set screw or spring clips.

ix. Bare Piping in Equipment Rooms: Split casting, cast brass type.

x. Bare Piping in Equipment Rooms: Split plate, stamped steel type with set screw or spring clips.

xi. Bare Piping at Floor Penetrations in Equipment Rooms: Split casting, floor plate type.

2. Sleeves are not required for core drilled holes, ***except in mechanical and electrical rooms or other wet areas where sleeves shall extend 2 inches above finished floor and shall be made watertight.***

3. Permanent sleeves are not required for holes formed by removable PE sleeves.

4. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

   a. Cut sleeves to length for mounting flush with both surfaces.

      i. Exception: Extend sleeves installed in floors of mechanical and electrical equipment areas or other wet areas 2 inches above finished floor level. Extended cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

   b. Install sleeves in new walls and slabs as new walls and slabs are constructed.

   c. Install sleeves that are large enough to provide ¼ inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   d. Steel Pipe Sleeves: For pipes smaller than 6 inches.

      i. Steel Pipe Sleeves: For pipes 6 inches and larger, penetrating gypsum-board partitions.

      ii. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast iron soil pipe to extend sleeve to 2 inches below finished floor level. Refer to Section 076200 – Sheet Metal Flashing and Trim for flashing.

   e. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Joint Seals for materials and installation.

5. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeves size to allow for 1 inch annular clear space between pipe and sleeves for installing mechanical sleeve seals.

   a. Install steel pipe for sleeves smaller than 6 inches in diameter.

   b. Install cast iron “wall pipes” for sleeves 6 inches and larger in diameter.

c. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

6. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section 078400 – Firestopping Systems for materials.

7. Verify final equipment locations for roughing-in.

8. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

END OF SECTION

SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2015.

B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

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

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 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.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturers:
   1. JP Lamborn Co; Thermal Sleeve MT: www.jpflex.com/#sle.
   2. or as approved.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. K (Ksi) Value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): www.aeroflexusa.com/#sle.
   2. Armacell LLC; AP Armaflex: www.armacell.us/#sle.
   3. K-Flex USA LLC; K-Flex Titan: www.kflexusa.com/#sle.
   4. or as approved.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
   2. Maximum Service Temperature: 180 degrees F (82 degrees C).
   3. Connection: Waterproof vapor barrier adhesive.

2.04 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation: www.jm.com/#sle.
      b. or as approved.

2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
   b. Maximum Service Temperature: 150 degrees F (66 degrees C).
   c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
   d. Thickness: 10 mil (0.25 mm).
   e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

END OF SECTION

SECTION 23 2300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Strainers.

F. Filter-driers.

G. Expansion valves.

H. Flexible connections.

1.02 REFERENCE STANDARDS

A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.

B. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

D. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2016.

E. ASME B31.9 - Building Services Piping; 2014.

F. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2016.

G. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with ASME B31.9 for installation of piping system.

2.02 PIPING

A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
   1. Fittings: ASME B16.22 wrought copper.
   2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.

2.03 REFRIGERANT

2.04 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.05 VALVES

A. Service Valves:
   1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi (3450 kPa).

2.06 STRAINERS

A. Straight Line or Angle Line Type:
   1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa).

2.07 FILTER-DRIERS

A. Performance:
   1. Flow Capacity – As per manufacturer, rated in accordance with AHRI 710.
   2. Pressure Drop: 2 psi (14 kPa), maximum, when operating at full connected evaporator capacity.
   3. Design Working Pressure: 350 psi (2410 kPa), minimum.

B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

C. Construction: UL listed.
   1. Connections: As specified for applicable pipe type.

2.08 EXPANSION VALVES

A. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.

B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F (6 degrees C) superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.09 FLEXIBLE CONNECTORS

A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches (230 mm) long with copper tube ends; for maximum working pressure of 500 psi (3450 kPa).

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

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

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

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

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

E. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.5.

END OF SECTION

SECTION 23 5700

HEAT EXCHANGERS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shell and tube type heat exchangers.

B. Accessories and trim.

1.02 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data with dimensions, locations, and size of tappings and performance data.

C. Shop Drawings: Indicate dimensions, locations, and size of tappings and performance data.

D. Certificates: Certify that Products meet or exceed specified requirements.

E. Manufacturer's Instructions: Indicate installation and support requirements.

F. Operation and Maintenance Data: Include start up and shut down instructions, assembly drawings, and spare parts lists.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with ASME BPVC-VIII-1 for manufacture of tubular heat exchangers and heat exchanger shells.

2.02 SHELL AND TUBE TYPE HEAT EXCHANGER

A. Manufacturers:
   1. American Wheatley, a company of Global Flow Products, LLC: www.wheatleyhvac.com/#sle.
   2. Armstrong Pumps Inc: www.armstrongpumps.com/#sle.
   3. Baltimore Aircoil Company: www.baltimoreaircoil.com/#sle.
   4. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
   5. or approved equal.

B. Comply with ASME BPVC-VIII-1 for manufacture of tubular heat exchangers and heat exchanger shells.

C. Tubes: U-tube type with 3/4 inch (20 mm) OD minimum seamless copper tubes suitable for 125 psi (860 kPa) working pressure.

D. Shell: Steel pipe with threaded or flanged piping connections and necessary tappings, steel saddle and attaching U-bolts, prime coated.

E. Heads: Cast iron or fabricated steel with steel or bronze tube sheets, threaded or flanged for piping connections.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to permit removal of tube bundle with minimum disturbance to installed equipment and piping.

END OF SECTION

SECTION 23 6423
SCROLL WATER CHILLERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Air-cooled scroll water chillers.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 -Cast-in-Place Concrete: Concrete housekeeping pads.
B. Section 23 2113 -Hydronic Piping.
C. Section 23 2114 -Hydronic Specialties.
D. Section 26 0583 -Wiring Connections.

1.03 REFERENCE STANDARDS

A. AHRI 550/590 (I-P) -Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle; 2015.
B. ASHRAE Std 15 -Safety Standard for Refrigeration Systems; 2013.
C. ASHRAE Std 90.1 I-P -Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. ASME BPVC-VIII-1 -Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2017.
E. NEMA 250 -Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
F. UL 1995 -Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 -Administrative Requirements for submittal procedures.
B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Daikin Applied Americas, Inc; model AGZ101E: www.daikinapplied.com/#sle.
B. Trane Technologies, PLC; model CGAM: www.trane.com/#sle.
C. York, a brand of Johnson Controls International, PLC: www.york.com/#sle.
D. or approved equal.
E. Substitutions: See Section 01 6000 - Product Requirements.
    1. The chilled water system has been designed based on specific capacities and characteristics of equipment specified in this section and other sections.

2.02 AIR-COOLED SCROLL WATER CHILLERS

A. Chillers: Factory assemble and test chiller consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, starters, and microprocessor-based controls.

1. Rating: AHRI 550/590 (I-P).
2. Safety: UL 1995 and ASHRAE Std 15.
3. Construction & Testing: ASME BPVC-VIII-1 as applicable for construction type.
4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.
5. Energy Efficiency: ASHRAE Std 90.1 I-P.
6. Enclosures:
   a. Frame: 1) Heavy-gauge steel. 2) Factory apply hot-dipped galvanized or air-dried paint finish.
   b. Steel Chiller Cabinets: 1) Factory apply baked-on enamel or baked-on powder paint finish.
   c. Electrical Equipment: NEMA 250 or UL 1995 as applicable.

2.03 COMPRESSORS AND EVAPORATOR

A. Compressors: Hermetic scroll type.

1. Unit: Fully hermetic type with multiple, direct-drive compressors with discharge and suction service valves.
2. Vibration Control: Factory installed internal isolators or field installed external isolators.
3. Oil Lubrication System: Initial oil charge, oil sump, heater, oil level, and sight glass.
4. Capacity Reduction System: Compressor staging with control down to 12 percent of full load without the activation of hot gas by-pass.
5. Motor: 3,600 or 3,500 rpm, suction gas-cooled, with thermal or current overload protection.

B. Evaporator: Provide shell and tube or brazed plate type.

1. Shell and Tube Type:
   a. Shell, removable heads, and tube support sheets constructed of carbon steel.
   b. Tubes: Mechanically expand and fasten, seamless, externally or internally enhanced, copper tubes into intermediate tube support sheets along the length of shell to avoid contact and relative motion between tubes.
   c. Refrigerant Working-Side Pressure Rating: 400 psig (2758 kPa) minimum.
   d. Water Working-Side Pressure Rating: 150 psig (1034 kPa) minimum.
   e. Provide with flanged or grooved connections.
   f. Insulation for all cold surfaces. 1) Insulation is factory or field installed on shell, connections, and suction piping. 2) 0.75 inches (20 mm) minimum thickness, closed cell, expanded polyvinyl chloride,
      1. polyurethane, or vinyl nitrate polymer insulation with a maximum k value of 0.28.
   g. Provide factory or field installed vents and water drain connections on evaporator or piping.
   h. Provide factory or field installed fittings for temperature control sensors on evaporator or piping.
   i. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F (minus 28.9 degrees C).
2. Brazed Plate Type:
   a. Plate Material: 316 stainless steel.
   b. Refrigerant Working-Side Pressure Rating: 430 psig (2965 kPa) minimum.
   c. Water Working-Side Pressure Rating: 150 psig (1034 kPa) minimum.
   d. Provide with flanged or grooved connections.
   e. Insulation for all cold surfaces. 1) Insulation is factory or field installed on evaporator, connections, and suction piping. 2) 0.75 inches (20 mm) minimum thickness, closed cell, expanded polyvinyl chloride,
   f. Polyurethane, or Armaflex II insulation with a maximum k value of 0.28. Provide factory or field installed vents and water drain connections on evaporator or piping.
   g. Provide factory or field installed fitting for temperature control sensors on evaporator or piping.
   h. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F (minus 28.9 degrees C).

2.04 REFRIGERATION CIRCUITS

A. Provide multiple independent refrigeration circuit(s) with one or multiple compressor(s) per circuit.
B. Provide liquid line shut-off valve, filter-drier, expansion valve, and refrigerant relief device for each independent circuit.

2.05 INTEGRATED MICROPROCESSOR BASED DDC CONTROLS PACKAGE

A. Pre-wire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gauges, on-auto-off switch, motor starters, disconnect switches, power and control wiring. Provide controls, monitoring, programmable set-points, alarms, and BAS as defined below:
   1. Automatic Adjustable Operating Controls:
      a. Temperature of chilled water leaving chiller.
      b. Chiller system capacity control based on set-points and system load.
      c. Compressor short-cycling prevention.
      d. Lead/lag for multiple compressors.
      e. Automatic reset on power source failure.
      f. Load limiting.
   2. Normal Operation Monitoring and Open Cover-less Displays:
      a. Hours of operation.
      b. Suction and discharge refrigerant pressures.
      c. Automatic diagnostics.
      d. Number of starts.
      e. On/off compressor status.
      f. Entering and leaving chilled water temperatures.
      g. Status of operation.
      h. Weekly purge cycle totalization if applicable.
      i. Oil pressure.
   3. Set-Points:
      a. Leaving chilled water temperature.
      b. Date/time.
   4. Automatic Chiller Shut-Down Safety Controls and Alarm:
      a. Automatic Reset: 1) Chilled water flow interlock. 2) Voltage protection (over/under). 3) Phase reversal protection.
      b. Manual Reset: 1) Evaporator low pressure. 2) High motor winding temperature. 3) Low chilled water temperature. 4) Low chilled water flow. 5) High condenser refrigerant discharge pressure. 6) Motor current overload and phase loss. 7) Low oil flow.
      c. Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
   5. Building Automation System (BAS) Communications via Shielded Cable:
      a. Minimum Data Transmission to BAS: 1) All system operating conditions. 2) Capacity control information. 3) Safety shutdown conditions.
      b. Minimum Operating Commands from BAS: 1) Remote unit start/stop. 2) Remote chilled water reset.

B. System must be able to connect to the Johnson Controls Metasys system. Controls can be removed from existing chiller and installed in new chiller at discretion of contractor or provide new controls. As part of contract, include cost of all programming required to make system operational in unit and at hind end computer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Align chiller package on steel or concrete foundations.
C. Install units on vibration isolators.
D. Connect to electrical service.
E. Connect to chilled water piping.
F. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.02 CLOSEOUT ACTIVITIES

A. See Section 01 7800 -Closeout Submittals for additional submittals.
B. See Section 01 7900 -Demonstration and Training for additional requirements.
C. Demonstrate proper operation of equipment to Owner's designated representative.

3.03 MAINTENANCE

A. Provide a separate maintenance contract for specified maintenance service.

3.04 WARRANTY

A. Provide a 5-year manufacturer’s warranty for all equipment.
B. Provide a 2-year contractor warranty for all labor for the chiller.

END OF SECTION