SECTION 232113 - HVAC PIPING, VALVES AND SPECIALTIES

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this section shall include, but not necessarily be limited to, the following:

1. Pipe and Fittings:
    a. Condensate piping from cooling coils (Coordinate with Plumbing, remove if condensate is covered by division 22)
2. Condensate pumps
3. Piping specialties:
    a. Drip pans
    b. Dielectric unions and flanges
    c. Unions
    d. Flanges
    e. Pipe sleeves
    f. Sleeve seals
    g. Pipe coating

B. In addition, provide the following:

1. Furnish accessories and labor for flushing and cleaning HVAC piping.

C. Condensate disposal drainage piping is required per the applicable mechanical code. Reference Division 22 for additional condensate drainage piping. (Coordinate with Plumbing, remove if condensate is covered by division 23).

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01: General Requirements.

B. Division 22: Plumbing.

C. Division 23: Mechanical.

1. Section 230500: Basic HVAC Materials and Methods.
2. Section 230548: Vibration Isolation for Piping Ductwork and Equipment.
3. Section 230549: Seismic Restraint for Piping Ductwork and Equipment.
4. Section 230593: Testing, Adjusting and Balancing.

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1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

B. Codes and Standards:

1. All work shall be in full accordance with all applicable codes, ordinances and code rulings.
2. The Contractor shall furnish without any extra charge the labor and material required for compliance of codes.
3. Perform all tests required by governing authorities and as required under all Division 23 Sections. Provide written reports on all tests.
4. Electrical devices and wiring shall confirm to the latest standards of NEC; all devices shall be UL listed and so identified.
5. All HVAC work shall comply with the Americans with Disabilities Act (ADA).
6. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

C. Product Control

1. Protection: Use all means necessary to protect materials before, during, and after installation and to protect the installed work and materials of all other trades.
2. The general arrangement and locations of piping are shown on the Drawings. Changes may be necessary to accommodate work. If project conditions require deviations from arrangement or location indicated to meet existing conditions or due to interference with work of other trades, such deviations as offsets, rises and drops in piping that may be necessary, whether shown or not, shall be made without extra expense. Accuracy of data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for assistance and guidance, and exact locations, distances, and elevations will be governed by actual site conditions.
3. All work shall be in accordance with the applicable codes listed in Division 01. No extra charge will be paid for furnishing items required by the regulations but not specified herein or shown on the Drawings. Should there be any direct conflict between the Drawings and/or Specifications and the above rules and regulations, the rules and regulations shall take precedence.
4. All work shall be completely coordinated, and all lines, grades, slopes and vertical and horizontal locations of pipes shall be exactly determined in the field and cleared with the Owner's Representative before the installation of these items is begun. No extra compensation shall be made for failure to observe this clause.
5. The Drawings and Specifications do not undertake to list every item that will be installed. When an item is necessary for the satisfactory operation of the system, it shall be furnished without extra cost. Work called for in the Specifications, but

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not on the Drawings, or vice versa, shall be done as though required by both. Lack of specific mention of any work necessary for proper completion of the work in the Specifications and/or Drawings, shall not lessen the Contractor's responsibility.

6. Obtain Owner's Representative's approval prior to rerouting of existing services. Refer to Division 01 sections for alterations, shutdown and temporary construction for existing services.
7. Pipe spaces provided in the design shall be utilized and the work shall be kept within the spaces established on the Drawings.
8. Manufacturers' directions shall be followed in all cases where manufacturers of articles used in this Contract furnish directions covering points not shown on the Drawings or specified herein. Manufacturers' directions do not take precedence over the Drawings and Specifications. Where manufacturers' directions conflict with the Drawings and Specifications, submit these conflicts to the Owner’s Representative and receive clarification before installing the work.
9. Do not permit or cause any work to be covered or enclosed until it has been inspected, tested, and approved. Should any of the work be enclosed or covered before inspection and test, Contractor shall, at his/her own expense, uncover the work; and, after it has been inspected, tested and approved, make all repairs with such materials as may be required. Restore all work to its original and proper condition.
10. Be responsible for damage to any of this work before acceptance. Securely cover all openings, both before and after setting into place, to prevent obstructions in the pipes and breakage.
11. Repair all damage to the premises occasioned by the work. All damage to any part of the premises caused by leaks or breaks in the pipe installed under this Section of the work for a period of one (1) year after date of final acceptance of the work, shall be repaired.

D. All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

E. Welding Standards:

1. Welding Qualifications:

   a. Certification: Each welder shall have a current AWS QC7 welding certification with successful completion of written test and welding samples in compliance with AWS D1.1. The welder must maintain their certification to show qualified welding experience every six months. The Owner’s Representative reserves the right to request sample coupon test welds of each welder to validate quality of welding work.

2. Welding Procedures:

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a. Steel Support Welding: All work shall be performed in compliance with American Welding Society AWS D1.1/D1.1M-Structural Welding Code-Steel.
b. Pipe Welding: All work shall be performed to meet or exceed the requirements of the American Welding Society AWS B2.1 Specification for Welding Procedure and Performance Qualification and ASME Boiler & Pressure Vessel Code: Section IX “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.”

F. Pressure Piping Standards

a. Comply with ASME B31.1 Power Piping, ASME B31.3-Process Piping and ASME B31.9-Building Services Piping standards for materials, products, and installation per pressure and temperature operating class.
b. Comply with ASME B31.9 Building Services Piping standard for the following services:

1) Conveying fluid between 0°F (-18°C) to 250°F (121°C).
2) Fluid pressure less than 350 psig.

G. Press Joint Fittings

1. Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of applicable press joint systems.
2. Press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer.
3. The installation of press joint fittings shall conform to all local code requirements.
4. ASME Compliance: ASME B31.9 for building services piping valves.

1.5 DEFINITIONS

A. ECM: Electronically commutated motor.

B. EPDM: Ethylene propylene diene monomer.

C. EPR: Ethylene propylene rubber.

D. FKM: Fluoroelastomer polymer.

E. HI: Hydraulic Institute.

F. NBR: Nitrile rubber or Buna-N.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data for all piping, valves and specialties indicating dimensions, valve CV, flow capacity, pressure setting, tolerances etc.

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B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, valve replacement, and spare parts lists. Include this data, product data, and shop drawings in operating and maintenance manuals.

C. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable mechanical coupling style number.

D. Delegated-Design Submittal for each vibration isolation, expansion joint and seismic-restraint device.

1. Seismic restraint calculations must be provided for all connections to the structure.
2. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Provide flexible joints, supports and piping joints as required to accommodate movement across seismic expansion joints and vertical building drift between floors.
4. Design: Design and calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints and loops.
5. Anchor Details: Detail fabrication of each anchor. Show dimensions and methods of assembly and attachment to building structure. Supports, anchors, and guides shall be designed for combined gravity, seismic, pressure, and thermal loads.
6. Alignment Guide Details: Detail field assembly and attachment to building structure.
7. Schedules: Each expansion joint/expansion loop shall be scheduled with manufacturer, type, material, size, pressure rating, end connections, and location.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver unit to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect equipment and products against dirt, water, chemical, and mechanical damage. Do not install damaged unit - remove from project site.

1.8 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 230500 for additional warranty and Substantial Completion requirements.

C. Provide the following additional extended warranty requirements that apply to piping with mechanical type joints and fittings, such as grooved or pressed/compression type fittings.

1. The warranties and corrective obligations provided under this section: (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty

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or other obligation (including any corrective obligation) of the Contractor or Manufacturer; (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced; and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

2. Contractor and Manufacturer warrant that, for a period of two (2) years from the date of Substantial Completion, the entire system, including but not limited to the fittings and joints, will conform to the requirements of the Contract Documents, will be free from defects, and will not leak.
3. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

1. All pipe, pipe fittings and valves shall be manufactured in North America. Alternatives may be acceptable, but must be submitted and approved by the Owner’s Representative prior to bidding.

OR

2. Upon request, the Owner’s Representative shall be furnished certification by the manufacturer, stating samples representing each lot have been tested and inspected as indicated in governing ASTM specifications have been met. Certification shall be accompanied by test reports as prepared in accordance with relevant ASTM sections governing Test Methods and Inspection. Tension Tests reports shall include breaking load, machined diameter of the test bars, and calculated tensile strength. Certification shall include the legal name and address of the manufacturer.

B. Type M copper piping is not acceptable for any pressure water piping unless specifically noted otherwise.

C. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise.

2.2 PIPE AND FITTINGS

A. Condensate and Indirect drains from cooling coils (Gravity Flow):

1. Copper Tubing: ASTM B88 or B75, Type K, Type L, or Type M hard drawn copper water tube for aboveground.

a. Fittings:

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1) ASME B16.18 cast copper alloy or ANSI/ASME B16.22 wrought copper with the following connection methods.
2) Soldered or brazed: ASTM B32, solder, Grade 95TA.
   a) 2” and smaller: Make connections using 95%-5% tin-antimony solder joints aboveground or Sil-Fos brazing.

2. Insulate condensate drain pipes with minimum 1/2" insulation to prevent moisture dripping from pipe, refer to Section 230719 HVAC Piping Insulation

2.3 PIPING SPECIALTIES

A. General:

1. Provide factory fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is installer's option.

B. Unions:

1. Unions shall be of type specified in following schedule:
   a. Soldered Copper or Brass Pipe, 2" and smaller: 150 lb. cast bronze or copper, ground joint, non-ferrous seat with soldered ends.
   b. Screwed Copper or Brass Pipe, 2" and smaller: 150 lb. cast brass, ground joint, brass to brass seat, with threaded ends.
   c. Flanged Copper or Brass Pipe, 2-1/2" and larger: two (2) 150 lb. cast bronze flanges.
   d. Where grooved joint piping systems are utilized, unions are not required. Grooved joint couplings shall serve as unions.
   e. Manufacturers: EPCO, Mueller, Stanley G. Flagg, Victaulic, Tyco-Grinnell, Watts.

C. Pipe Sleeves:

1. Provide fire proof sleeve assemblies utilizing UL rated sealant systems at all fire rated penetrations. For non-rated sleeve penetrations pack the annular space between the pipe and sleeve with fiberglass and/or mastic.
2. Sleeves shall provide a minimum 1/2-inch annular clearance around pipe.
3. Sheet metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3" and smaller, 20-gauge; 4" to 6", 16-gauge; over 6", 14-gauge.
4. Plastic and copper pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.
5. Sleeves through interior concrete walls and floors. Floor sleeves to extend a minimum of 4” above finished floor. Telescopic, submerged, or adjustable sleeves. Manufacturers: Adjust-to-Crete, AMI, Shamrock.

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6. Through exterior walls and floor on grade: 150-pound class cast-iron pipe sleeve. Where waterproof membranes are used, provide membrane clamps. For insulated piping, sleeve diameter shall not be less than diameter of insulated pipe.
7. Cast-in-place watertight device for protecting penetrating objects from expansion and contraction of concrete. Factory-assembled for use in cast-in-place concrete floors and walls and consisting of two outer sleeves and a one-piece radial extended-flange waterstop gasket, with mid-body seal for embedment and sealing to concrete slab and continuous water seal extending to the penetrating pipe.
    a. Outer Sleeves: EPDM or NBR attached to the mid-body seal forming an area with which to attach the device to the structural reinforcing rod determining the position of sleeve in the wall.
    b. Water Stop Mid-Body Seal: Flexible polymer seal with radial extended flange consisting of one to three concentric raised rings which lock into concrete, maintaining seal over time as concrete contracts from sleeve
    c. Manufacturers: Hubbard Enterprises/HOLDRITE, Hydro Preseal.

D. Sleeve Seals:

1. All sleeves shall be sealed to prevent intrusion of moisture, dust or insects.
2. Aboveground: For sleeves passing through walls or floors provide a non-toxic 3-hour rated fire resistant silicone foam sealant with a Flame Spread Rating of 20. Sealant to be tested and approved under UL 263, ASTM E119, and NFPA 251 Standards. All fire rated penetrations shall be sealed with approved UL System.
3. Local Approvals: All seals to be provided shall be in accordance with the regulations of all governing agencies of the city, county, and State Fire Marshal's Office.

E. Drip Pans:

1. Provide drip pans fabricated from 20-gauge galvanized sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top by structural angles. Provide hole, gasket, and flange at low point for watertight joint and 1" copper drain line connection.

2.4 EXPANSION COMPENSATORS AND FLEXIBLE PIPING CONNECTIONS

A. General: Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. All piping mains, branches and runouts shall be installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Stresses shall be within allowable limits of ANSI B31.1 for pressure piping. Vertical piping for chilled water, heating water, and condenser water shall be provided with system flexibility to allow expansion compensation at each floor level without inducing stresses on branch piping. Expansion products to conform to the standards of the Expansion Joint Manufacturer's Association. Expansion joints shall not require packing. Installer shall select materials and pressure/temperature ratings to suit

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intended service. Select packless expansion joints to provide 150% absorption capacity of calculated maximum piping expansion between anchors. All connections shall have ends to match piping system application.

B. Flexible Connection for Copper Pipe: Bronze hose and braid, copper tube ends. Provide steel supports to prevent sagging is required. Manufacturers: Metraflex #BBS, Unisource #V-BF11 Style, Mason Industries.

C. Flexible Rubber Connectors (Pump Connections): Flexible spherical expansion joints for pump connections. Shall employ peroxide cured EPDM in the covers, liners and Kevlar tire cord frictioning. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes 3/4" to 1 1/2" may have threaded bolted flange assemblies, one sphere and cable retention. 14" and smaller connectors shall be rated at 250 psi up to 190F with a uniform drop in allowable pressure to 190 psi at 250F. 16" and larger connectors are rated 180 psi at 190F and 135 psi at 250F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5-minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Manufacturer shall provide pre-stretching charts for expansion joints when used in conjunction with isolated equipment. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have 1/2" thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut off valves. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves. Manufacturers: Mason #SAFEFLEX SFDEJ Series, #SAFEFLEX SFEJ Series, #SAFEFLEX SFDCR Series or #SAFEFLEX SFU Series and Control Rods Mason #CR, or equal.

1. (Note to Editor: Don’t use three grooved joints in lieu of flexible connectors unless required by the owner. Many acoustical consultants do not agree that these are equivalent to flexible couplings with more vibration transmitted from the pump to the piping system.) Three grooved joint flexible type couplings may be used in lieu of flexible connectors on steel pipe for vibration attenuation and stress relief. Grooved joint couplings shall be placed in close proximity to the vibration source. For services up to 250°F. Manufacturers: Victaulic #Style 177 or 77 or Gruvlok #FIG 7401.

D. Expansion Joints for Grooved Piping: For piping systems fabricated from grooved pipe and couplings, use one of the following methods for expansion compensation:

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1. Combination Couplings and Nipples: Provide expansion joints constructed of grooved short pipe nipples and flexible couplings, designed by manufacturer to suit intended service. Provide removable ties to hold joint compressed or expanded during piping fabrication, depending on application. Total joint end movement is dependent on the number of couplings/nipples in the joint. Select couplings and gasket materials to match balance of piping system. Manufacturers: Victaulic #Series 155 or Gruvlok #FIG 7240.
2. Slip-Type Expansion Joints: Provide slip-type expansion joints constructed of carbon steel pipe and couplings, designed by manufacturer to suit intended service. Joint shall be gasketed expansion joint, with grooved ends. Slide section coated with PTFE modified PPS (Polyphenylene Sulfide) coating. Joint suitable for axial end movement up to 3". Select couplings and gasket material to match balance of piping system. Manufacturer: Victaulic #Style 150.
3. Three flexible couplings: Use three flexible couplings for the first three connections in close proximity to a pump or chiller to eliminate flexible rubber connectors. Manufacturers: Victaulic #177, 75 or 77, Tyco-Grinnell #Fig. 705 and 707, or Gruvlok #FIG 7401.

2.5 CONDENSATE PUMPS

A. Furnish and install automatic condensate pumps with capacities and lift as shown on plans, or where not indicated, capacities shall align with connected equipment.

B. The contractor shall verify that the vertical lift of the condensate pump at the required flow rate is greater than the installed vertical distance from the condensate pump outlet up to discharge into the gravity drainage system.

C. Tank type condensate pumps shall have a 0.5 gallon reservoir, float switch, check valve, and alarm output signal for equipment shutdown. Power shall be via 120V or 230V plug as indicated on plans. Manufacturer: Little Giant.

D. Inline type condensate pumps for ductless split systems shall be self-priming, with integral anti-siphon device and inline fuse. Pumps shall have a 120/230V universal input and be powered from the split system terminal block. Manufacturer: Aspen.

2.6 SUPPORTS AND ANCHORS (SEE SECTIONS 230500 AND 230549)

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal or otherwise irregular work unless so indicated on Drawings or approved by the Owner's Representative.

C. Coordinate mounting and attachment of piping with Structural Engineering design.

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D. Coordinate the work between the various Mechanical Sections and with the work specified under other Divisions of the work or contracts toward rapid completion of the entire project. If any cooperative work must be altered due to lack of proper supervision or failure to make proper provisions in time, then the work hereunder shall include all expenses of such changes as are necessary in the work under other contracts, and such changes shall be directly supervised by and made to the satisfaction of the Owner's Representative.

E. The cooperative work not included in the Mechanical Division related to the general construction work is as follows:

1. All formed concrete work.
2. Framed openings in masonry and other Architectural and Structural elements.
3. Wood grounds and nailing strips in masonry and concrete.

F. Inspect all material, equipment, and apparatus upon delivery and do not install any that may be subject to rejection as a result of damage or other defects. Provide tarps and waterproof material cover to protect equipment and piping delivered to and stored at the site.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturer's directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications. Provide additional valves, strainers, unions, etc. as required by manufacturer installation instructions.

3.3 WORKING PRESSURES

A. All fittings, valves, pipe, specialties equipment shall be rated for the working pressure subjected in the installed locations.

B. Drawings indicate working pressure in each system. The rating of the equipment and material shall not be less than that of the system pressures.

3.4 PIPE SIZES TO EQUIPMENT

A. General: Pipe sizes indicated on drawings shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of equipment.

B. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valve.

3.5 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints or couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated)

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by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance. Comply with ASME B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2 inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

C. Install expansion joints, expansion loops, expansion bends, and similar units to accommodate project seismic movement across building expansion joints and in vertical risers to accommodate drift between vertical buildings levels.

D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

E. Install lateral bracing with pipe hangers and supports to prevent swaying.

F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

I. Elevator Machine Rooms, Switchgear, Generator, Telecommunications, Telephone Rooms, and Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

J. Cleaning: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any).

3.6 CONDENSATE DISPOSAL

A. Provide equipment bases and curbs with enough height to provide a minimum of 8” clearance between bottom of equipment condensate outlet and adjoining surface to allow for adequate installation space for the condensate trap.

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1. Install manufacturer provided condensate “air-traps” where provided with cooling equipment and condensing boilers. Install traps per manufacturer’s instructions and install condensate piping as required by local code.

(Coordinate with plumbing, remove the rest of this section if condensate is covered by division 22)

B. Primary drain pan shall be provided with cooling coil and extend beyond the leaving side of the coil and underneath the cooling coil connections.

C. All condensate drain lines from each piece of equipment shall be piped full size of the unit drain outlet, with “P” trap or manufactured Air Trap, and piped to nearest drain. See details shown on the drawings or the manufacturer’s instructions for depth of air conditioning condensate trap to exceed unit static pressure. Condensate drain lines shall not be less than 3/4" internal diameter and shall not decrease in size from the outlet of the equipment to the place of condensate disposal.

D. Equipment manufacturer shall provide outlet size to align with condensate drain sizing tables in the mechanical and plumbing codes. Unit outlet size shall be 3/4" for equipment capacity to 20 ton of refrigeration and 1” for equipment capacity over 20 tons to 40 tons of refrigeration.

E. Run horizontal indirect waste condensate drainage piping at uniform pitch of not less than 1/8" per foot (1%).

F. Where mechanical cooling equipment is located in a space where damage is capable of resulting from condensate overflow, including damage to replaceable lay-in ceiling tiles, secondary protection shall be provided by one of the following methods:

1. Install a secondary drain pipe at a level that is higher than the primary drain pipe connection of the drain pan for mechanical equipment above rigid ceilings and route to visible location or approved receptor.
2. Install a water level detecting device that will shut off the equipment or appliance in the event the primary drain is blocked. Coordinate with mechanical design for this option to be provided with mechanical equipment.
3. Install an additional watertight pan of corrosion-resistant material, with a separate drain pipe, installed beneath the cooling coil, unit, or appliance to catch overflow condensate due to a clogged primary condensate drain and route to visible location or approved receptor.

3.7 CONDENSATE PUMPS

A. Clean evaporator and condensate drainage surfaces of all debris, oils and foreign materials prior to operating pump.

3.8 PIPING SYSTEM JOINTS

A. All piping shall be cut squarely, free of rough edges and reamed to full bore. Piping shall be mechanically cleaned prior to make-up of joints and fully inserted into fittings.

B. Provide joints of type indicated in each piping system.

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C. Piping shall be capped during construction to prevent entry of foreign material.

D. Thread pipe in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

E. Soldered copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM. B-32, in accordance with IAPMO IS 3-93, ASTM B-828 and Copper Development Association recommended procedures. Joints shall be cleaned by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes shall be applied liberally to the outside of the pipe and the solder cup of the fitting. Fluxes shall be water soluble for copper and brass potable water applications and shall meet CDA standard test method 1.0 and ASTM B813-91. Solder shall be applied until a full fillet is present around the joint. Solder and flux shall not be applied in such excessive quantities as to run down interior of pipe. Lead solder or corrosive flux shall not be present at the jobsite. Soldered joints shall only be installed where complete access is available on all sides of the pipe to assure that visual inspection can occur for 360° circumference. Blind soldering is not allowed, in such cases the use of mechanical type fittings shall be utilized. This would apply to situations such as pipes attach tight to floor or ceiling/roof requiring mechanical type joints.

1. Manufacturers:

a. Solder: JW Harris "Bridgit" or Englehard "Silvabrite 100".
b. Flux: Laco "Flux-Rite 90", MW Dunton "Nokorode CDA Flux", Hercules "Fluid Action Solder Flux".

F. Braze copper tube and fitting socket or mechanically formed tee fittings with BCUP series filler metal without flux. Listed brazing flux shall be used for joining of copper tube to brass or bronze fittings and shall meet AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet shall be visible around the completed joint. After cooling, flux residue shall be thoroughly removed with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10% nickel.

1. Brazing fittings may use a mechanically limited depth that is not less than the minimum cup depth (overlap) specified by ANSI/ASME B16.50 for Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings. Manufacturer of mechanical dimpler: Brazing Dimpler Corp.

G. Depth of solder joint and braze joint fitting:

Depth of Solder Joint and Braze Joint Fittings		
Pipe Size (inches)	ASME 16.22 Solder Joint Socket Depth (inches)	ASME B16.50 Brazed Joint Socket Depth (inches)
1/2	0.50	0.22

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3/4	0.62	0.25
1	0.75	0.28

H. Weld pipe joints in accordance with recognized industry practice and as follows:

1. Weld pipe joints only when ambient temperature is above 0°F.
2. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
3. Use pipe clamps or tack-weld joints with 1” long welds, 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and at edges of each weld. Weld by procedures which will ensure elimination of unsound or un-fused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.
5. Do not weld out piping system imperfections by tack-welding procedures. Re-fabricate to comply with requirements.
6. With engineering pre-approval stub-in saddle taps may be acceptable for aboveground branch connections, in non-critical areas, where the branch size is less than 50% of the main size and where branch sizes are 3”, or smaller, in diameter. Pipe main must be larger than 8” diameter in a renovation project for consideration.

I. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

J. Grooved Joints:

1. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall meet AWWA C-606 requirements.
2. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer.
3. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
4. Grooved coupling manufacturer’s factory trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

K. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing such as copper to zinc plated equipment fittings or copper to galvanized steel or black steel equipment:

    a. Dielectric Fittings for NPS 2” (DN 50)] and Smaller: Use dielectric couplings, nipples, unions.

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b. Dielectric Fittings for NPS 2-1/2” to NPS 4” (DN 65 to DN 100): Use dielectric flange kits or threaded nipples.
c. Dielectric Fittings for NPS 5” (DN 125) and Larger: Use dielectric flange kits.

2. Dielectric couplings are not required in the following locations:

a. Unions in a copper piping system with connections to brass/bronze valves and devices.
b. Unions in a copper piping system with connections to stainless steel valves and devices.

L. Adhesive Bonded Joints: All joints installed or constructed in the field shall be assembled by employees of the contractor who have been trained and certified to the bonding procedure specification provided by the pipe manufacturer. This specification shall meet or exceed the requirements of ASME B31.3, Section A328.2.1. The pipe manufacturer or their authorized representative shall train the contractor’s employees in the proper joining and assembly procedures required for the project including hand-on participation by the contractor’s employees in accordance with the manufacturer’s specification.

M. Vic-Press 304™ Joints: Install fitting in accordance with the manufacturer’s installation instructions. The joints shall be pressed using the tool(s) approved by the manufacturer. Pipe shall be certified for use with the Vic Press 304™ system. Pipe shall be square cut, +/- 0.030”, properly deburred and cleaned. Pipe ends shall be marked at the required location, using a manufacturer-supplied gauge, to ensure full insertion into the coupling or fitting during assembly. Use a Victaulic ‘PFT’ series tool with the proper sized jaw for pressing.

N. Press connections: copper and copper alloy press connections shall be installed in accordance with the manufacturer’s installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

3.9 IDENTIFICATION MARKERS (SEE SECTION 230500)

3.10 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1” minimum annular clear space between piping/insulated piping and concrete slabs and walls.

Note to Editor: Retain subparagraph below when cast-in-place watertight sleeve seals are required.

1. When cast-in-place watertight sleeve seals are required, select sleeve size to match the size and type of pipe to be installed.

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Note to Editor: Retain subparagraph below if applicable.

2. Sleeves are not required for core-drilled holes.

C. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4” (6.4 mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
4. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping." Exception: When fire-resistance-rated cast-in-place watertight sleeve seals are required for floor penetrations, additional firestopping is not necessary.

3.11 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

C. Aboveground, Cast-in-Place Watertight Sleeves. Select sleeve size based on pipe size, material to be inserted and thickness of wall.

1. Install cast-in-place watertight sleeves for pipes NPS 6 (DN 150) and smaller in diameter.
2. Position cast-in-place watertight sleeve in wall space securing sleeve to reinforcing steel using tie wire.

D. Fire-Resistance Rated, Cast-in-Place Sleeve Installation: Select sleeve size based on size and type of pipe and thickness of the floor. Position and secure sleeve to concrete form using nails or staples.

3.12 PIPE INSPECTIONS

A. It is the intent of the Contract Documents that systems be inspected at completion of each phase while under tests required for administrative authorities, and prior to concealment, i.e. "Rough-in" "Top-out" and final.

B. All piping shall be inspected upon completion and prior to finish of walls and ceilings by the Owner's Representative. Contractor must notify the Owner’s Representative no less than 24 working hours prior to inspection time. Should the piping be hidden within

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the structure prior to inspection approval the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

3.13 FLUSHING AND CLEANING PIPING SYSTEMS

A. Clean systems with chemicals specified in Section 232500 HVAC Water Treatment. Follow the method provided below or a method recommended by the suppliers of the chemicals specified in Section 232500.

1. General Initial flushing:

a. Remove loose dirt, mill scale, metal chips, weld beads, rust, and similar deleterious substances without damage to any system component.
b. Provide temporary piping or hoses to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place.
c. Isolate or protect clean system components, including pumps and pressure vessels, and remove any components which may be damaged.
d. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris-carrying velocity of 3 to 6 feet per second, if possible.
e. Connect dead-end supply and return headers as necessary. Flush bottoms of risers.
f. Install temporary strainers where necessary to protect down-stream equipment.
g. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and contractor’s booster pumps.
h. Flush until clean as approved by the Owner’s Representative.

2. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body using the velocity of this throttling action. Flush for not less than one hour. Fill entire system with clean water and vent all air.

3.14 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Testing shall be witnessed by an independent third-party inspector. Upon completion of testing, certify to the Owner’s Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by third party inspector.

B. Piping: Remove from the system, during testing, all equipment which would be damaged by test pressure. Replace removed equipment when testing has been accomplished. The systems may be tested in sections as the work progresses;

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however, any previously tested portion shall become a part of any latter test of a composite system. Correct leaks by remaking joints with new material. During construction the installer may incrementally test portions of the piping system as allowed by the local mechanical code and/or ASME B31.1/B31.3/B31.9 as applicable.

END OF SECTION 232113

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