

**SECTION 23 23 00
REFRIGERANT PIPING**

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 ADDITIONAL RELATED DOCUMENTS

- A. The following Division 23 Sections:
 - 1. "HVAC Piping Insulation", for insulation, jackets, and accessories.
 - 2. "Hangers and Supports for Piping and Equipment", for refrigerant piping supports and hangers.

1.3 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications, including tubing, hangers and supports, fittings, isolation valves, and specialties; special-duty valves; and refrigerants. It also includes delegated design requirements.
- B. Scope of Work: The Contractor shall provide a complete and functional refrigerant piping system for systems requiring field installed refrigerant piping. The Contractor shall also provide for the detailed design of that piping system, including, but not limited to, piping quantities, pipe sizing, hangers and supports, expansion compensation, valves and other refrigerant specialties, oil traps, and the required refrigerant and oil charges. The piping design shall comply with the equipment manufacturer's recommendations and requirements.

1.4 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

1.5 ACTION SUBMITTALS

- A. General: Submit product data for the type of tubing proposed, and for each fitting and valve type and refrigerant piping specialty specified.
 - 1. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings and Delegated Design: Prepare to-scale drawings showing the detailed layout of refrigerant piping, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
 - 1. Refrigerant piping indicated on the Drawings is schematic only. Sizes, if indicated, are for reference and initial design and coordination purposes only. The Contractor shall size all piping and design the layout and installation of the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment, and all manufacturer requirements and recommendations.
 - 2. The equipment manufacturer shall furnish all piping system requirements to the Contractor. Then pipe sizing calculations shall then be performed by the Contractor based on the shop drawing layout of the system. Calculations to determine the required amount of oil shall also be performed. The equipment manufacturer shall then review the final shop drawings and piping sizing, and issue the piping design certification letter described below.
- B. Certified Piping Design Verification Letter: From the equipment manufacturer certifying that the Contractor's proposed piping system sizing and layout meets all of the manufacturers requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For refrigerant valves and piping specialties to include in the operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Installers of refrigerant piping systems shall have EPA 608 Type II or Universal certification. EPA certification for R410A is also required for those installations using R-410A refrigerant.
- C. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- D. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- E. Comply with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical."

1.9 STORAGE AND HANDLING

- A. Cover refrigerant tubing allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect tubing and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings by storage inside or by durable, waterproof, above ground packaging.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Refrigerants:
 - a. Atofina Chemicals, Inc.
 - b. DuPont Company; Fluorochemicals Div.
 - c. Honeywell, Inc.; Genetron Refrigerants.
 - d. INEOS Fluor Americas LLC.
 - e. Or equal as approved by the Professional.
 - 2. Refrigerant Valves and Specialties:
 - a. Eaton Corporation; Industrial Control Div.
 - b. Henry Technologies.
 - c. Streamline, a Div. of Mueller Industries
 - d. Sporlan; a Div. of Parker Hannfin Corp.
 - e. Or equal as approved by the Professional.

2.2 TUBES

- A. Copper Tube: ASTM B 280, Type ACR, drawn temper.

2.3 TUBE FITTINGS

- A. Copper Fittings: ANSI/ASME B16.22, wrought-copper solder type fittings, streamlined pattern.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8.
 - 1. Use Type BCuP (copper-phosphorus) alloy meeting AWS 'BCuP-3' specification (e.g. Sil-Fos 5, or approved equal) for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

2.5 VALVES AND SPECIALTIES

- A. Ball Valves: Minimum 700 psig working pressure and 250 deg F. working temperature. Forged brass or bronze body, full port internally equalized ball, copper extension stubs, blowout proof stem and sealed cap, PTFE ball seals, double stem seals, bi-directional isolation (up to full pressure rating), integral Schrader-type access port, and socket end connections.
- B. Service Valves: Minimum 600-psig pressure rating, forged-brass body with copper extension stubs, brass caps, isolatable Schrader-type access port, integral ball check valve, and solder-end connections.

C. Check Valves:

1. Body: Forged brass, or cast bronze; Y-type globe pattern.
2. Bonnet: Screwed or bolted forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 600 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket.
6. Working Pressure Rating: 600 psig.
7. Maximum Operating Temperature: 240 deg F.

E. Replaceable-Core Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal, as recommended by refrigeration equipment manufacturer.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 600 psig.
9. Maximum Operating Temperature: 240 deg F.

F. Liquid Accumulators: Comply with AHRI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket.
3. Working Pressure Rating: 600 psig.
4. Maximum Operating Temperature: 275 deg F.

G. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket.
4. Working Pressure Rating: 600 psig.
5. Maximum Operating Temperature: 275 deg F.

H. Flexible Connectors:

1. Construction: Deep pitch corrugated tubing with wire braid outer reinforcement.
2. Materials: Stainless steel or brass.
3. Working Pressure Rating: 620 psig for sizes up to 2-1/8".
4. Minimum Length: 7 inches for sizes 3/4" and smaller, and 11 inches for sizes larger than 3/4".
5. Manufacturer: Packless Metal Hose Inc., models 'VAFS' and 'VAF', or approved equal.

2.6 REFRIGERANT

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

2.7 REFRIGERANT PIPING COVERING SYSTEM

- A. Scope: Provide covering system on exterior refrigerant piping where the piping is routed on or along an exterior wall or other finished building surface, and where indicated on the Drawings. Where the covering system is provided, the metal jacketing on exterior piping specified in Division 23 Section "HVAC Piping Insulation" may be omitted.
- B. Description: A complete factory fabricated range of straight duct sections, couplings, elbows, tees, wall flanges/escutcheons, wall inlet covers, soffit / ceiling entry fittings, reducers, end socket fittings, mounting clips and brackets, wall sleeves, and flexible sections. All portions of the exterior portion of the refrigerant piping system shall be fully enclosed with the system.
- C. Materials: UV-resistant PVC with stainless steel fasteners, round or rectangular profile.
1. Factory Finish: Off-white or cream colored PVC as selected by the Architect.
- D. Acceptable Manufacturers: Subject to compliance with the project requirements, provide products by one of the following:
1. CoverGuard
 2. Diversitech - 'SpeediChannel'
 3. Mitsubishi Electric - 'Line-Hide'
 4. Rectorseal/ Inaba Denko - 'Slimduct PD'
 5. Sauermann 'Easy Lineset Duct'
 6. Or equal as approved by the Professional.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Route piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. All aspects of the completed refrigerant piping system shall satisfy all recommendations and requirements of the manufacturer of the equipment to which the piping system is connected.
- C. Install refrigerant piping according to ASHRAE 15.
- D. Basic piping installation requirements are specified in Division 23 Section "Common Work Results for HVAC."
- E. Select system components with pressure rating equal to or greater than system operating pressure.
- F. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.
- G. Elbows shall be of the long radius type.
- H. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves in accessible locations to allow for service and inspection.
- I. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- J. Insulate refrigerant suction and liquid piping with flexible elastomeric insulation. Insulate suction lines and liquid lines separately. Refer to Division 23 Section "HVAC Piping Insulation".
 - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- K. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.
- L. Install copper tubing in rigid galvanized steel conduit in locations where copper tubing will be exposed to mechanical injury.
- M. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor, except that lines on heat pumps shall be installed level.
 - 3. Liquid lines may be installed level.
 - 4. Install traps and double risers to entrain oil in vertical runs, where recommended by the equipment manufacturer.
- N. Use fittings for changes in direction and branch connections.
- O. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- P. Reduce pipe sizes using eccentric reducer fittings installed with level side down.

- Q. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.
- R. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.
- S. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC".
- T. Lineset Covering Systems: Provide a complete lineset covering system to conceal refrigerant piping, and control conduits and AC condensate piping associated with the same refrigeration / cooling equipment, where the refrigerant piping is located in a finished space below a finished ceiling, or is located outside and installed along an exterior finished wall surface. Also provide where indicated on the Drawings.

3.3 HANGERS AND SUPPORTS

- A. General: Hangers, supports, and anchors are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Provide according to ASME B31.5 and ANSI / MSS SP-58.
- B. Accommodate thermal expansion and contraction of the piping system. Comply with requirements in Division 23 Section "Expansion Fittings and Loops for HVAC Piping".
- C. Metallic pipe hangers of dissimilar material shall not come in direct contact with refrigerant piping. Utilize hangers that support the piping on the outside of the insulation.
- D. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
- E. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
- F. Pipe rollers for multiple horizontal runs, 20 feet or longer supported by a trapeze.
- G. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes, or in accordance with ANSI / MSS-SP-58, whichever is more demanding. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- I. Provide additional hangers at each change of direction of piping and at concentrated equipment loads.

3.4 PIPE JOINT CONSTRUCTION

- A. Basic pipe and tube joint construction, along with brazing filler materials, is specified in Division 23 Section "Common Work Results for HVAC."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
 - 1. Fill pipe and fittings with a dry, inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.
 - 2. Utilize brazing flux compatible with filler metals.
- C. Flared and threaded compression couplings / fittings are not permitted.
- D. Connections to Heat-Sensitive Valves and Specialties: Wrap the body of the valve/specialty with a wet rag to dissipate heat. Use large enough torch to rapidly heat joint to brazing temperature. Direct flame away from existing copper to brass joints. Quench to reduce heat spread after brazing.

3.5 VALVE AND PIPING SPECIALTY APPLICATIONS AND INSTALLATION

- A. Furnish and install refrigerant valves and specialties according to manufacturer's written instructions and the refrigeration system manufacturer's recommendations and requirements.
- B. Piping connections to units provided with externally applied vibration isolation shall include flexible connectors.
- C. Install ball valves complying with this Section on suction and discharge of evaporator units and condensing units to allow for servicing.
 - 1. It is the intention of these specifications that all other refrigerant specialties are factory furnished with the packaged refrigeration system equipment, and installed by the Contractor. However, any specialties not furnished with the refrigeration equipment package but required to conform to the equipment manufacturer's requirements and recommendations shall be furnished and installed by the Contractor, and those specialties shall conform to the requirements of this Section.
- D. Unless explicitly required or recommended otherwise by the refrigeration equipment manufacturer, the Contractor shall provide refrigeration specialties as follows:
 - 1. Install ball valves in suction and discharge lines of compressor.
 - 2. Install service valves as a means to provide gage taps at inlet and outlet of hot-gas bypass valves and strainers if gage taps are not an integral part of hot gas bypass valves and strainers.
 - 3. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
 - 4. Install ball valves on inlet and outlet side of filter dryers.
 - 5. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - a. Install valve so diaphragm case is warmer than bulb.
 - 6. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.

7. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
8. Install safety relief valves where required by the ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
9. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
10. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - a. Solenoid valves.
 - b. Thermostatic expansion valves.
 - c. Hot-gas bypass valves.
 - d. Compressor.
11. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
12. Install receivers sized to accommodate pump-down charge.
13. Refrigerant circuit access ports located outdoors, other than those on rooftop and in other secured locations, shall be fitted with a locking type tamper resistant caps.

3.6 PIPING SYSTEM LEAK TESTING

- A. Leak test new piping systems. The Contractor shall perform leak tests. Advise the Client Agency and Architect/Engineer no less than 7 days in advance of testing.
- B. Test prior to installing insulation.
- C. Leak Tests and Inspections:
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article in this Section.
 - a. Fill system with dry nitrogen and appropriate tracer gas to the required test pressure. All manual valves and the solenoid valves shall be open.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector having a certified sensitivity of one ounce per year. The use of ultrasonic leak detectors is also acceptable.
 - d. Remake leaking joints using new materials, and retest the isolated, repaired area until satisfactory results are achieved.
 - e. After all leaks have been repaired and retested, the entire system shall stand at the required test pressure, with all valves open, for no less than 12 hours. The pressure at the beginning and end of the test period shall be measured using the same pressure gauge and recorded.
 - f. If the pressure change is not more than a 2 psig, release the nitrogen charge to the atmosphere (make sure you have adequate ventilation), and begin the evacuation and charging process.

3.7 SYSTEM EVACUATION AND CHARGING

- A. No refrigerant shall be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- B. Evacuate and charge system using procedures no less stringent than the following:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate the system with a vacuum pump to an absolute pressure not exceeding 1,500 microns while the system ambient temperature is above 60 deg. F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Leave the vacuum pump running for not less than one (1) hour without interruption, evacuating to an absolute pressure not exceeding 400 microns. Then, with the pump valved off from the system, and the system equalized, the vacuum level shall be recorded and held for a minimum of 6 hours with a maximum upwards drift of 100 microns permitted over that period. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.
 - 3. Charge system with a new filter-dryer core in charging line.
 - 4. Charge system with refrigerant and oil as recommended by equipment manufacturer. Add additional refrigerant and oil, as calculated, per the manufacturer's requirements. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.
- C. If the equipment manufacturer requires or recommends an evacuation method more stringent than the above, the manufacturer's procedures shall be followed.

3.8 ADJUSTING

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

END OF SECTION