

**SECTION 23 23 00**  
**REFRIGERANT PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.
- B. Meet the following performance requirements:
  - 1. Line Test Pressure for Refrigerant R-410A in accordance with Code:
    - a. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
    - b. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).
- C. For the Refrigerant Based Precision cooling system, provide refrigerant piping between indoor cooling unit (CRAC) and the air cooled condenser (ACC). Refer to the drawings for specific information.
- D. Provide refrigerant R-410A for Refrigerant Based Precision Cooling Systems (section 23 81 23).

**1.2 RELATED SECTIONS**

- A. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.
- B. Section 23 07 00 – Insulation.
- C. Section 23 81 23i – Refrigerant Based Precision Cooling System.

**1.3 COORDINATION**

- A. Coordinate work under provisions indicated in Section 23 00 10.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
  - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
  - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment per manufacturer requirements.

**1.4 QUALIFICATIONS / QUALITY ASSURANCE**

- A. Conform to requirements indicated in Section 23 00 10.
- B. Provide welding certificates
- C. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- D. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

- E. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- F. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

#### **1.5 REGULATORY REQUIREMENTS**

- A. Conform to requirements indicated in Section 23 00 10.

#### **1.6 SUBMITTALS**

- A. Submit as required under Section 23 00 10.

#### **1.7 EXTRA MATERIALS**

- A. Furnish under provisions indicated in Section 23 00 10.

#### **1.8 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions indicated in Section 23 00 10.

#### **1.9 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions indicated in Section 23 00 10.

#### **1.10 WARRANTY**

- A. Provide under provisions indicated in Section 23 00 10.

### **PART 2 - PRODUCTS**

#### **2.1 COPPER TUBE AND FITTINGS**

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

#### **2.2 VALVES AND SPECIALTIES**

- A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
  3. Operator: Rising stem and hand wheel.
  4. Seat: Nylon.
  5. End Connections: Socket, union, or flanged.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
  2. Packing: Molded stem, back seating, and replaceable under pressure.
  3. Operator: Rising stem.
  4. Seat: Non-rotating, self-aligning polytetrafluoroethylene.
  5. Seal Cap: Forged-brass or valox hex cap.
  6. End Connections: Socket, union, threaded, or flanged.
  7. Working Pressure Rating: 500 psig.
  8. Maximum Operating Temperature: 275 deg F.

### **2.3 REFRIGERANTS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atofina Chemicals, Inc.
  2. DuPont Company; Fluorochemicals Div.
  3. Honeywell, Inc.; Genetron Refrigerants.
  4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## **PART 3 - EXECUTION**

### **3.1 PIPING:**

- A. Suction and Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

### **3.2 VALVE AND SPECIALTY APPLICATIONS**

- A. Service valves as recommended by equipment manufacturer and in accordance with good engineering practices.

### **3.3 GENERAL PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated and size according to manufacturer's recommendations based on elevation change and length of pipe runs unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping adjacent to machines to allow service and maintenance.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- I. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- J. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- K. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install traps and double risers to entrain oil in vertical runs., as required.
  - 3. Liquid lines may be installed level.
- L. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- M. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- O. Install sleeves through roof, walls, or ceilings, sized to permit installation of full-thickness insulation.
- P. Seal pipe penetrations through roof according to Division 07 Section "Joint Sealants" for materials and methods.
- Q. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

### **3.4 REFRIGERANT PIPING GUIDELINES FOR REFRIGERANT BASED PRECISION COOLING SYSTEMS**

- A. Air-cooled units ship with a nitrogen holding charge. Do not vent the evaporator until all refrigerant piping is in place, ready for connection to the unit and condenser.
- B. Use copper piping with a brazing alloy with a minimum temperature of 1350°F (732°C), such as Sil-Fos. Avoid soft solders, such as 50/50 or 95/5.

- C. Use a flow of dry nitrogen through the piping during brazing to prevent formation of copper oxide scale inside the piping. When copper is heated in the presence of air, copper oxide forms. POE oils will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components.
- D. A pure dry nitrogen flow of 1-3 ft<sup>3</sup>/min (0.5-1.5l/s) inside the pipe during brazing is sufficient to displace the air. Control the flow using a suitable measuring device.
- E. Ensure that the tubing surface to be brazed are clean and that all burrs have been removed from the ends of the tubes.
- F. Ensure that all loose material has been cleaned from inside the tubing before brazing.
- G. Protect all refrigerant line components within 18 in. of the brazing site by wrapping them with a wet cloth or with a suitable heat-sink compound.
- H. Isolate piping from building using vibration-isolating supports.
- I. The outlet of the receiver must be higher than the elevation of the electronic-expansion valve (EEV) inside the indoor unit. If the vertical height is greater than 60 ft consult the factory. Condensers with receivers cannot be installed below the evaporator.
- J. Consult factory if piping run exceeds 200 ft linear length or 300 ft equivalent length.
- K. Install traps on hot-gas (discharge) lines at the base of vertical risers over 5 ft and every 20 ft or evenly-divided over the vertical rise. The DA250 has internally-installed traps on the hot-gas lines.
- L. Pitch horizontal hot-gas piping down at a minimum rate of 1/2 in. per 10 ft so that gravity will aid in moving oil in the direction of refrigerant/oil flow.
- M. Keep piping clean and dry, especially on units with R-410A refrigerant.
- N. Charge systems with refrigerant as recommended by the manufacturer installation instructions.
- O. Add oil of the types, viscosities and quantities as recommended by the manufacturer installation instructions.

### **3.5 PIPE JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

### **3.6 HANGERS AND SUPPORTS**

- A. Hanger, support, and anchor products are specified in Division 23 Section "Supports and Anchors".

- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
  - 4. Spring hangers to support horizontal and vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
  - 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 7/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 4. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
  - 5. NPS 1 3/8: Maximum span, 72 inches; minimum rod size, 1/4 inch.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

### 3.8 SYSTEM CHARGING

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

### 3.9 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 or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  - 1. 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.
  4. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**END OF SECTION**