

## **SECTION 23 23 00 - REFRIGERANT PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

#### **1.2 SUBMITTALS**

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- 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. 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.
- C. Field quality control test reports.
- D. Operation and maintenance data.
- E. Complete Refrigeration Compliance Manager (RCM) contract input and equipment input forms. The Owner will provide these forms.

#### **1.3 QUALITY ASSURANCE**

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- C. All refrigeration work shall be performed by a subcontractor with a valid City of Seattle Refrigeration Mechanics license. The subcontractor shall also have an A&B Refrigeration Handlers Certificate with a Universal Rating as required by 40 CFR Part 82F of EPA Regulations.

#### **1.4 PRODUCT STORAGE AND HANDLING**

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

## 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. Brazing Filler Metals: ANS A58.

### 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. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
  - 1. Body and Bonnet: Plated steel.
  - 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  - 3. Seat: Polytetrafluoroethylene.
  - 4. End Connections: Threaded.
  - 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2 inch conduit adapter, and [24] [115] [208]-VAC coil.
  - 6. Working Pressure Rating: 400 psig.
  - 7. Maximum Operating Temperature: 240 deg F.
  - 8. Manual operator.
- C. Thermostatic Expansion Valves: Comply with ARI 750.
  - 1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  - 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  - 3. Packing and Gaskets: Non-asbestos.
  - 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  - 5. Suction Temperature: 40 deg F.
  - 6. Superheat: Adjustable.
  - 7. Reverse-flow option (for heat pump applications).
  - 8. End Connections: Socket, flare, or threaded union.
  - 9. Working Pressure Rating: 700 psig.

D. Straight Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100 mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

E. 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 ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Replaceable Core Filter Dryers: Comply with ARI 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.
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: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

G. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
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: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

## 2.3 REFRIGERANTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
  - 1. Atofina Chemicals, Inc.
  - 2. DuPont Company; Fluorochemicals Div.
  - 3. Honeywell, Inc.; Genetron Refrigerants.
  - 4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-134a.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

### 3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- B. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- C. Install replaceable-core filter dryers for systems 5 tons and larger. Install permanent filter dryers for systems less than 5 tons.
- D. Install a full sized, three-valve bypass around replaceable core filter dryers.
- E. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- F. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. 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.
  - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- G. 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.

- H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
- I. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

### 3.3 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 unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. 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.
- L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

N. When 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.

O. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

R. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

S. Identify refrigerant piping and valves according to Division 23 Section "Identification for Mechanical Piping and Equipment."

### 3.4 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube." All pipe joints shall be brazed with no mechanical coupling allowed. Nitrogen purge all pipes during brazing.

B. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.

C. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

### 3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for Mechanical Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58 Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support 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, 3/8 inch.
  2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 3/8 inch.
  3. NPS 1: Maximum span, 72 inches; minimum rod size, 3/8 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.
- D. Support multifloor vertical runs at least at each floor.

### 3.6 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 and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
    - 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. Subject completed systems to an operating test as stipulated in the Mechanical Refrigeration Ordinance, Field Test Section 14.1-3 and Instructions 15.107. The Owner's Representative will witness this test.

### 3.7 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.

### 3.8 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 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. Open shutoff valves in condenser water circuit.
  - 2. Verify that compressor oil level is correct.
  - 3. Open compressor suction and discharge valves.
  - 4. Open refrigerant valves except bypass valves that are used for other purposes.
  - 5. 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 23 23 00**