

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

### **PART 1      GENERAL**

#### **1.01      REFERENCES**

A.    The following is a list of standards which may be referenced in this section:

1.    Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 760, Performance Rating of Solenoid Valves for Use with Volatile Refrigerants.
2.    American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): 15, Safety Standard for Refrigeration Systems.
3.    American Society of Mechanical Engineers (ASME):
  - a.    B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - b.    B31.5, Refrigeration Piping and Heat Transfer Components.
4.    American Welding Society (AWS):
  - a.    A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
  - b.    BRH, Brazing Handbook.
5.    ASTM International (ASTM): B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
6.    National Electrical Manufacturers Association (NEMA).
7.    UL.

#### **1.02      DEFINITIONS**

- A.    ACR: Air conditioning and refrigeration.
- B.    NRTL: National Recognized Testing Laboratory.

#### **1.03      SUBMITTALS**

- A.    Action Submittals: Manufacturer's data on refrigerant piping, piping products, thermostatic expansion valves, solenoid valves, hot-gas bypass valves, filter dryers, strainers, pressure regulating valves and accessories.
- B.    Informational Submittals:
1.    Welding certificates.
  2.    Field quality control; test report.
  3.    Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

#### 1.04 QUALITY ASSURANCE

- A. Safety Code Compliance: Comply with applicable portions of ASHRAE 15.
- B. Brazing: Comply with applicable requirements of ASME B31.5 pertaining to brazing of refrigerant piping for shop and Project Site locations.
- C. Installer: A firm with at least 5 years of successful installation experience on projects with refrigerant piping similar to that required for this Project.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Refrigerant piping shall be cleaned, dehydrated, and sealed when delivered.
- B. Store piping in clean and protected area with end caps in place.

### **PART 2 PRODUCTS**

#### 2.01 MATERIALS

- A. Material and dimensional requirements for field assembled refrigerant piping, valves, fittings, and accessories shall conform to ASHRAE 15 and ASME B31.5.
- B. Piping, 3 Inches and Smaller: Copper, Type ACR tube, ASTM B280, copper No. 122, hard-drawn temper. Brazed joints required.
- C. Fittings for Copper Tube: Wrought-copper/bronze solder-joint fittings in accordance with ASME B16.22.
- D. Pipe Insulation: Refer to Section 23 07 00, HVAC Insulation.

#### 2.02 MISCELLANEOUS PIPING PRODUCTS

- A. Brazing Materials:
  - 1. Physical Characteristics:
    - a. Provide 15 percent silver alloy brazing material for copper to copper and copper to brass fittings.
    - b. Comply with AWS A5.8M/A5.8 for brazing filler materials.
  - 2. Functional Characteristics: None.
  - 3. Performance Characteristics: None.

B. Refrigerant Specialties:

1. Refrigerant Suction Line Filter-Dryer:
  - a. Physical Characteristics:
    - 1) Provide steel shell, corrosion-resistant finish filter-dryer, with molded felt core with 10-micron particle retention, in size and working pressure indicated, with copper connectors, and access valve (not applicable for heat pump system).
    - 2) Provide size recommended by refrigeration equipment manufacturer.
  - b. Functional Characteristics: None.
  - c. Performance Characteristics:
    - 1) Operating Temperature Rating: 240 degrees F.
    - 2) Working Pressure: 500 psi.
2. Refrigerant Liquid Line Dryer:
  - a. Physical Characteristics:
    - 1) Provide refrigerant liquid line filter-dryer for all units.
    - 2) For heat pumps, provide biflow directional types (not required if included with air-conditioning equipment).
    - 3) Provide size recommended by refrigeration equipment manufacturer.
  - b. Functional Characteristics: None.
  - c. Performance Characteristics:
    - 1) Operating Temperature Rating: 240 degrees F.
    - 2) Working Pressure: 500 psi.

C. Refrigerant Valves:

1. Globe and Check Valves: Listed and labeled by an NRTL.
  - a. Manufacturers:
    - 1) Henry Technologies.
    - 2) Or equal.
  - b. Shutoff Valves:
    - 1) Physical Characteristics:
      - a) Forged brass, packed, back seating winged seal cap, 300 degrees F (140 degrees C) temperature rating 500 psi working pressure.
      - b) Valve required only if shutoff service valves are not included with package air-conditioning equipment.
    - 2) Functional Characteristics:
      - a) Maximum Opening Pressure: 0.5 psig.
    - 3) Performance characteristics: None.

2. Solenoid Valve: Listed and labeled by an NRTL.
    - a. Manufacturers:
      - 1) Alco Controls Div.; Emerson Electric Co.
      - 2) Or equal.
    - b. Physical Characteristics:
      - 1) Two-Way Solenoid Valves: Forged brass, designed to conform to AHRI 760, normally closed, polytetrafluoroethylene valve seat, NEMA 1 solenoid enclosure, 24 volts, 60-Hz, UL Listed, 1/2-inch conduit adapter.
      - 2) Provide valve only if recommended by air-conditioning equipment manufacturer.
      - 3) Manual Operator: Provide optional manual operator to open valve.
    - c. Functional Characteristics: 250 degrees F (121 degrees C) temperature rating 500 psi working pressure.
    - d. Performance Characteristics: None.
  3. Thermostatic Expansion Valve:
    - a. Manufacturers:
      - 1) Danfoss Group Global.
      - 2) Or equal.
    - b. Physical Characteristics:
      - 1) Body Bonnet and Seal Cap: Forged brass or steel.
      - 2) Diaphragm, Piston, Closing Spring and Seat Insert: Stainless steel.
      - 3) Capillary and Bulb: Copper tubing filled with refrigerant.
      - 4) End Connections: Socket or flare.
    - c. Functional Characteristics:
      - 1) Suction Temperature: 40 degrees F.
      - 2) Working Pressure: 700 psig.
    - d. Performance Characteristics: None.
- D. Refer to Section 40 05 15, Piping Support Systems, for piping shields and piping support requirements.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF PIPING SYSTEM**

- A. Install piping products in accordance with manufacturer's written instructions, applicable requirements of ASME B31.5, ASHRAE 15, and in accordance with recognized industry practices to ensure products serve intended function.
- B. Install dryers on liquid and suction lines.

C. Refrigerant Piping:

1. Cut pipe accurately to measurements established at Site and work into place without springing or forcing.
2. Install piping with sufficient flexibility to adequately provide for expansion and contraction as a result of temperature fluctuation inherent in its operation.
3. Where pipe passes through building structure, pipe joints shall not be concealed, but located where they may be readily inspected.
4. Run pipe to be insulated as shown and as required with sufficient clearance to permit application of insulation.
5. Run piping as shown, taking care to avoid interference with other piping, conduit or equipment. Except where specifically indicated otherwise, run piping plumb, and straight and parallel to walls and ceilings.
6. Trapping of lines shall not be permitted, except to entrain oil in vertical runs where double risers are also installed.
7. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
8. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
9. Install piping free of sags and bends.
10. Install fittings for changes in direction and branch connections.
11. Install refrigerant piping in protective conduit where installed belowground.
12. Install accumulator in suction line near condensing unit.
13. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
14. Slope refrigerant piping as follows:
  - a. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - b. Install horizontal suction lines with a uniform slope downward to compressor.
  - c. Install traps and double risers to entrain oil in vertical runs.
  - d. Liquid lines may be installed level.

D. Pipe Sleeves:

1. Provide pipe sleeves of suitable size for pipe and tubing that penetrate building structure.
2. Secure sleeves in position and location before and during construction. Space between pipe and sleeves, or between insulation and pipe sleeves, shall be not less than 1/4 inch between outside of pipe or insulation, and inside wall of sleeves.

3. Sleeves for uninsulated pipes shall have ends flush with finished wall surfaces; provide pipe or tubing as above with outside perimeter of pipe caulked to sleeve.
4. Extend sleeves for insulated pipes 1/2 inch from wall faces and caulk to sleeve on both sides.
5. Seal terminal ends of pipe insulation with mastic.
6. Extend sleeves for lines passing through floors 3 inches above finished floor slab and caulk to slab.
7. Seal penetrations through fire and smoke barriers according to Section 07 84 00, Firestopping.

E. Braze cap (seal) ends of piping when not connected to mechanical equipment.

### 3.02 SOLDER JOINTS

A. Solder joints shall not be used for joining refrigerant piping systems.

### 3.03 BRAZED JOINTS

A. Braze copper piping with silver solder complying with AWS A5.8M/A5.8.

B. Brazed Joints:

1. Construct joints according to AWS Brazing Handbook Chapter "Pipe and Tube".
2. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
3. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

C. Inside of tubing shall be free of flux.

D. Clean parts to be joined with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled.

E. Cool joints in air and remove flame marks and traces of flux.

F. During brazing operation, prevent an oxide film from forming on inside of tubing by slowly flowing dry nitrogen to expel air.

G. When brazing, 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.

### 3.04 PIPE HANGERS

A. Refer to Section 40 05 15, Piping Support Systems, for piping shields and piping support requirements.

### 3.05 EQUIPMENT CONNECTIONS

- A. Connect refrigerant piping to mechanical equipment in the manner shown and comply with equipment manufacturer's instructions where not otherwise indicated.

### 3.06 FIELD QUALITY CONTROL

#### A. General:

1. Notify Contracting Officer at least 48 hours before testing is performed.
2. Furnish equipment required for tests.
3. Group as many systems together as possible when testing in order to consolidate number of test inspections.

#### B. Leak Test:

1. Prior to initial operation, clean and test refrigerant piping in accordance with ASME B31.5.
2. Perform initial test with dry nitrogen to 300 psig minimum using soap solution to test joints.
3. Evacuate system after initial test and charge system with refrigerant or dry nitrogen, 20 percent refrigeration mixture to 600 psig minimum.
4. Upon completion of initial system test, test factory, as well as field, refrigerant piping joints with electronic-type leak detector to acquire a leak-tight refrigerant system.
  - a. If leaks are detected, remove entire refrigerant charge for the system, replace defective pipe or fitting, and retest entire system as specified above.

#### C. Evacuation, Dehydration, and Charging:

1. After system is found to be without leaks, evacuate system using reliable gauge and vacuum pump capable of pulling a vacuum of at least 1-mm Hg absolute (29.88-inch Hg gage).
2. Evacuate system with vacuum pump until temperature of 35 degrees F (2 degrees C) is indicated on vacuum dehydration indicator.
3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
4. Maintain vacuum on system for minimum of 12 hours after closing valve between vacuum pump and system. If system holds vacuum for 12 hours, it is ready for charging.
5. Break vacuum with refrigerant gas or dry nitrogen gas, allowing pressure to build up to 2 psi (15 kPa).
6. Install new filter-dryer core in charging line.
7. Repeat evacuation procedure and complete charging of system; provide full operating charge.

### 3.07 ADJUSTING

#### A. General:

1. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
2. Adjust high-pressure and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
3. Adjust setpoint temperature of air-conditioning controllers to system design temperature.
4. Perform following adjustments according to manufacturer's written instructions before operating refrigeration system:
  - a. Verify compressor oil level is correct.
  - b. Open compressor suction and discharge valves.
  - c. Open refrigerant valves, except bypass valves that are used for other purposes.

- B. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

#### **END OF SECTION**