

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Valves and specialties.
4. Refrigerants.

B. Reference and Industry Standards

Enterprise Green Communities Criteria

1. Mandatory Requirements: See the current edition of the NYC overlay of the EGC reference standard for full specifications.
 - a. NYC New Construction projects must achieve at least 60 optional points, and Substantial and Moderate Rehab projects must also achieve at least 55 optional points.

C. Comply with current edition of the New York City Energy Conservation Code.

D. Comply with HPD-NYSERDA Retrofit electrification pilot technical requirements-Split system heat pump for space heating.

E. <https://www.nyc.gov/site/hpd/services-and-information/sustainability.page>

F. <https://www.nyc.gov/site/hpd/services-and-information/blds.page>

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: [ASTM B 88, Type K or L (ASTM B 88M, Type A or B)] [ASTM B 280, Type ACR].
- B. Wrought-Copper Fittings, Solder-Joint: ASME B16.22.
- C. Wrought-Copper Fittings, Brazed-Joint: ASME B16.50.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- F. Brazing Filler Metals: AWS A5.8/A5.8M.
- G. 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- (180-mm-) long assembly.
 - 4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).
- H. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:
 - 1. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
 - 2. Housing: Copper.
 - 3. O-Rings: HNBR or compatible with specific refrigerant.
 - 4. Tools: Manufacturer's approved special tools.
 - 5. Minimum Rated Pressure: 700 psig (48 bar).

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

- 1.
2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

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: Nonrotating, 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 (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, 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, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Refrigerant Locking Caps:

- 1.
2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant charging ports from unauthorized refrigerant access and leakage.
3. Material: Brass, with protective shroud or sleeve.
4. Refrigerant Identification: [Color-coded, refrigerant specific] [or] design.
5. Special Tool: For installing and unlocking.

- F. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (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 (16-GRC) conduit adapter, and 24 115 208-V ac coil.
 6. Working Pressure Rating: 400 psig (2760 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
- G. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig (2760 kPa).
 6. Maximum Operating Temperature: 240 deg F (116 deg C).
- H. Thermostatic Expansion Valves: Comply with AHRI 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 (4.4 deg C)] <Insert temperature>.
 6. Superheat: [Adjustable] [Nonadjustable].
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: [700 psig (4820 kPa)] [450 psig (3100 kPa)] <Insert value>.
- I. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 5. Seat: Polytetrafluoroethylene.
 6. Equalizer: [Internal] [External].
 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter and [24] [115] [208]-V ac coil.
 8. End Connections: Socket.
 9. Set Pressure: <Insert psig (kPa)>.
 10. Throttling Range: Maximum 5 psig (34 kPa).
 11. Working Pressure Rating: 500 psig (3450 kPa).
 12. Maximum Operating Temperature: 240 deg F (116 deg C).
- J. 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 (3450 kPa).

5. Maximum Operating Temperature: 275 deg F (135 deg C).

K. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 deg F (135 deg C).

L. 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 or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

M. 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] [charcoal].
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: [2 psig (14 kPa)] <Insert value>.
8. Rated Flow: <Insert tons (kW)>.
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

N. Permanent Filter Dryers: Comply with AHRI 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] [charcoal].
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: [2 psig (14 kPa)] <Insert value>.
8. Rated Flow: <Insert tons (kW)>.
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

2.4 REFRIGERANTS

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

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PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
- B. Hot-Gas and Liquid Lines[, and Suction Lines for Heat-Pump Applications]:
 - 1. Copper, **[Type ACR]** **[Type L (B)]**, annealed- or drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 2. Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 3. Copper, **[Type ACR]** **[Type K (A)]** **[Type L (B)]**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
 - 4. Copper, **[Type ACR]** **[Type K (A)]** **[Type L (B)]**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- C. Safety-Relief-Valve Discharge Piping:
 - 1. Copper, **[Type ACR]** **[Type L (B)]**, annealed- or drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 2. Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 3. Copper, **[Type ACR]** **[Type K (A)]** **[Type L (B)]**, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
 - 4. Copper, **[Type ACR]** **[Type K (A)]** **[Type L (B)]**, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install **[diaphragm packless]** **[packed-angle]** valves in suction and discharge lines of compressor.
- B. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install **[diaphragm packless]** **[packed-angle]** valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.

- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. 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.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. 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.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve[, **and in the suction line at the compressor**].
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.
- N. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to the authority having jurisdiction.

3.3 INSTALLATION OF PIPING, GENERAL

- 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 Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. 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.
- O. 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.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 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. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- 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.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. 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 vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within [12 inches (300 mm)] <Insert dimension> of each fitting.

- F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

- A. Perform the following 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 "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.
- B. Prepare test and inspection reports.

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 (67 Pa)**. 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 (14 kPa)**.
 - 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 232300