

**SECTION 23 23 00
REFRIGERANT PIPING**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field refrigerant piping for direct expansion HVAC systems.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Definitions:
 1. Refrigeration system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
 - a. Low side means the parts of a refrigeration system subjected to evaporator pressure.
 - b. High side means the parts of a refrigeration system subjected to condenser pressure.
 2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 450 degrees C (842 degrees F) but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS
- F. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS//

SPEC WRITER NOTE: If Section 13 05 41 is included in this project the section shall be obtained from VA Masters.

- G. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for piping.//
- H. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items which are common to more than one section of Division 23.
- I. Section 23 07 11, HVAC INSULATION: Requirements for piping insulation.
- J. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating, and Refrigeration Institute (AHRI):
 - 730-2013.....Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers
 - 750-2007.....Performance Rating of Thermostatic Refrigerant Expansion Valves
 - 760-2014.....Performance Rating of Solenoid Valves for Use with Volatile Refrigerants
- C. American National Standards Institute (ANSI):
 - Z535.1-2006 (R2011).....Safety Colors
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
 - 15-2013.....Safety Standard for Refrigeration Systems
 - 17-2008.....Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves
 - 34-2013.....Designation and Safety Classification of Refrigerants
 - 63.1-1995 (RA 2001).....Method of Testing Liquid Line Refrigerant Driers

- E. American Society of Mechanical Engineers (ASME):
- A13.1-2015.....Scheme for the Identification of Piping Systems
- B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint
Pressure Fittings
- B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged
Fittings, Class 150, 300, 600, 900, 1500, and
2500
- B31.5-2013.....Refrigeration Piping and Heat Transfer
Components
- B40.100-2013.....Pressure Gauges and Gauge Attachments
- B40.200-2008.....Thermometers, Direct Reading and Remote Reading
- F. American Society for Testing and Materials (ASTM)
- A126-2004 (R2014).....Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
- B32-2008 (R2014).....Standard Specification for Solder Metal
- B280-2013.....Standard Specification for Seamless Copper Tube
for Air Conditioning and Refrigeration Field
Service
- G. American Welding Society, Inc. (AWS):
- BRH-2007.....Braze Handbook, 5th Edition
- A5.8/A5.8M-2011.....Specification for Filler Metals for Brazing and
Braze Welding
- H. Underwriters Laboratories (UL):
- 207-2009 (R2014).....Standard for Refrigerant-Containing Components
and Accessories, Nonelectrical
- 429-2013.....Standard for Electrically Operated Valves

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 23 00, REFRIGERANT PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

D. Shop Drawings:

1. Sufficient information including valves and refrigerant piping accessories shall be included as to be able to clearly determine compliance with contract documents for components noted below:
 - a. Tubing and fittings
 - b. Valves
 - c. Strainers
 - d. Moisture-liquid indicators
 - e. Filter-driers
 - f. Flexible metal hose
 - g. Liquid-suction interchanges
 - h. Oil separators (when specified)
 - i. Gages
 - j. Pipe and equipment supports
 - k. Refrigerant and oil
 - l. Pipe/conduit roof penetration cover
 - m. Soldering and brazing materials

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

F. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

G. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

1.5 QUALITY ASSURANCE

- A. Refer to paragraph QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Comply with ASHRAE 15, Safety Standard for Refrigeration Systems (ANSI Approved), and ASHRAE 34, Designation and Classification of Refrigerants. The application of this Code is intended to assure the

safe design, construction, installation, operation, and inspection of every refrigeration system employing a fluid which normally is vaporized and liquefied in its refrigeration cycle.

- C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.
- D. Products shall comply with UL 207 and/or UL 429.

1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //____// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation

shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Refrigerant Piping: Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Provide coils tagged ASTM B280 by the manufacturer.
- B. Fittings, Valves and Accessories:
 - 1. Solder joints: Wrought copper fittings, ASME B16.22.
 - a. Solder, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
 - b. Solder, water, and drain: 95-5 tin-antimony, ASTM B32 (95TA).
 - 2. Flanges and flanged fittings: ASME B16.24.
 - 3. Refrigeration Valves:
 - a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, backseating.
 - b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE 15.
 - c. Solenoid Valves: Comply with AHRI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally //open// //closed// holding coil.
 - d. Thermostatic Expansion Valves: Comply with AHRI 750. Brass body with stainless steel or non-corrosive nonferrous internal parts, diaphragm, and spring-loaded (direct-operated) type, with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE 17.

- e. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Provide direction of flow indicator legibly and permanently on the valve body.
- 4. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines greater than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
- 5. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
- 6. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to AHRI 730 and ASHRAE 63.1. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Provide filter driers with replaceable filters with one spare element of each type and size.
- 7. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.

2.2 GAGES

- A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. Provide adjustable pointers. Provide rigid stem type temperature gages in thermal wells located within 1500 mm (5 feet) of the finished floor. Utilize universal adjustable angle type or remote element type temperature gages in thermal wells located 1500 to 2100 mm (5 to 7 feet) above the finished floor. Provide remote element type temperature gages in thermal wells located 2100 mm (7 feet) above the finished floor.

- B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Select each gage range so that at normal operating pressure, the needle is within the middle-third of the range.
1. Suction: 101 kPa (30 inches Hg) vacuum to 1724 kPa (250 psig).
 2. Discharge: 0 to 3447 kPa (0 to 500 psig).

2.3 PIPE SUPPORTS

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.4 REFRIGERANTS AND OIL

- A. Provide required refrigerant and oil for proper system operation.

2.5 PIPE/CONDUIT ROOF PENETRATION COVER

- A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 300 mm (12 inches) overall height, continuous welded corner seams, treated wood nailer, 40 mm (1-1/2 inch) thick, 48 kg/cu. m (3 lb/cu. ft.) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs constructed for pitched roof or ridge mounting as required to keep top of curb level.
- B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 40 mm (1-1/2 inch) thick mineral fiber board insulation.
- C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.6 PIPE INSULATION FOR DX HVAC SYSTEMS

- A. Refer to specification Section 23 07 11, HVAC INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE 15 and ASME B31.5.
1. Install piping as short as possible, with a minimum number of joints, elbows, and fittings.
 2. Install piping with adequate clearance between pipe and adjacent walls and hangers as to allow for service and inspection. Space

- piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surfaces. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat, and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.
 4. Use copper tubing in protective conduit when installed below ground.
 5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.
- C. Joint Construction:
1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
 - a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
 - b. Use Type BA_g, cadmium-free silver alloy for joining copper with bronze or steel.
 - c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
 - d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.
- D. Protect refrigeration system during construction against entrance of foreign matter, dirt, and moisture; have open ends of piping and connections to compressors, condensers, evaporators, and other equipment tightly capped until assembly.
- E. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.
- F. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC INSULATION.
- G. //Seismic Bracing: Refer to specification Section 13 05 41, SEISMIC RESTRAINTS REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS, for bracing of piping in seismic areas.//

3.2 PIPE AND TUBING INSULATION

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

- A. For each refrigeration system erected on the premises provide an easily legible permanent sign securely attached and easily accessible, indicating the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.
- B. For systems containing more than 50 kg (110 lb) of refrigerant provide with durable signs, in accordance with ASME A13.1 and ANSI Z535.1, having letters not less than 15 mm (1/2 inch) in height designating:
 - 1. Valves and switches for controlling refrigerant flow, the ventilation, and the refrigerant compressor(s).
 - 2. Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

3.4 FIELD QUALITY CONTROL

- A. Prior to initial operation, examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

3.5 FIELD TESTS

- A. After completion of piping installation and prior to initial operation, conduct tests on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of COR. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.
 - 1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms, and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
 - 2. Test the high and low side of each system and prove tight at not less than the lower of the design pressure or the setting of the

- pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.
- B. Test Medium: Use a suitable dry gas such as nitrogen for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.6 SYSTEM TEST AND CHARGING

- A. System Test and Charging: As recommended by the equipment manufacturer or as follows:
1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 69 kPa (10 psig). Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
 2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
 3. Evacuate the entire refrigeration system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigerant to be charged and charge with the proper volume of refrigerant.

3.7 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

- C. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

3.8 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.9 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hour//s// to instruct each VA personnel responsible in the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

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