

**CONSTRUCTION STANDARD SPECIFICATION**

**SECTION 15183**

**REFRIGERANT SYSTEMS**

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## CONSTRUCTION STANDARD SPECIFICATION

### SECTION 15183

#### REFRIGERANT SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Materials and operations required for the installation of built-up and packaged split system refrigeration systems, including piping, fittings, equipment, refrigeration accessories, refrigerants, and lubricating oil, joints, testing, evacuation and charging, and vibration isolators.
- B. Recovery and reclamation of refrigerants from equipment that is to be removed or modified shall be by SNL personnel only. The contractor shall schedule such work through the Sandia Construction Observer (SCO).
- C. Related Sections: Refer the to following sections for related work;
  - Section 01330, "Submittal Procedures"
  - Section 07270, "Firestop and Smokestop Systems"
  - Section 09900, "Painting"
  - Section 13943, "Facilities Control Systems"
  - Section 15050, "Basic Mechanical Materials and Methods"
  - Section 15083, "Pipe and Equipment Insulation"
  - Section 15200, "Vibration Limits and Control"
  - Section 15901, "Systems Component Checkout and Balance"

##### 1.02 REFERENCES

The current editions of the following codes and standards are a part of this specification;

American Society of Mechanical Engineers Standards and American National Standards (ASME/ANSI):

ANSI B16.22	Wrought Copper and Copper Alloy Solder-joint Pressure Fittings
ANSI B31.5	Refrigeration Piping
ASME Sec. VIII	Boiler and Pressure Vessel Code - Unfired Pressure Vessels

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration

American Society for Testing and Materials (ASTM):

ASTM B280	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
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American Welding Society (AWS):

AWS A5.8	Specification for Brazing Filler Metal
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### 1.03 SUBMITTALS

- A. All required submittals shall be per Section 01330, "Submittal Procedures".
- B. Built-Up Systems: Product Data: Provide submittals for all piping materials, each type of valve and refrigerant piping specialty indicated.
- C. Packaged Split Systems: Refrigerant piping indicated is schematic only. Provide the equipment manufacturer's "Installation Manual" including required piping schematic. Size piping and design the actual piping layout, including oil traps, double risers, specialties, slopes of runs, required controls, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.

### 1.04 QUALITY ASSURANCE

ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

## PART 2 - PRODUCTS

### 2.01 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR, clean, dry and capped.
- B. Annealed-Temper Copper Tube: ASTM B 280, Type ACR, clean, dry and capped. Annealed copper tubing shall not be used for piping larger than 0.625 O.D.

- C. Wrought-Copper Fittings: ASME B16.22.
- D. Bronze Filler Metals: AWS A5.8, Classification BAg-7 (50 % silver), BCuP5 (15% Silver)

## 2.02 VALVES

- A. Lines 1" O.D. or smaller: Diaphragm Packless Valves: 500-psig working pressure and 275 deg F working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and hand-wheel, stainless-steel spring, nylon seat disc, with solder-end connections.
- B. Lines 1-1/8" O.D. or larger: Wing Cap Packed Valves: 450-psig working pressure and 275 deg F working temperature; straight-through or angled, forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, with solder-end connections.
- C. Check Valves Smaller Than NPS 1: 500-psig operating pressure and 285 deg F operating temperature; cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve shall be straight-through pattern, with solder-end connections.
- D. Check Valves, NPS 1 and Larger: 400-psig operating pressure and 285 deg F operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.
- E. Service Valves: 500-psig pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.
- F. Three-way dual shut-off valves for use with pressure relief valves. Henry Type 92.
- G. Solenoid Valves: Comply with ARI 760; 250 deg F temperature rating and 400-psig working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2-inch conduit adapter, and voltage and normal holding coil position as indicated on the drawings.
- H. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting. Valves shall be factory set to maintain an operating or standby pressure per ASHRAE 15 and not to exceed the receiver design pressure or pressure of the lowest rated piping component in the system.

- I. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.
- J. Capillary tubes are only allowed in packaged units, less than 10 tons.
- K. Hot-Gas Bypass Valve: Pulsating-dampening design, stainless-steel bellows and polytetrafluoroethylene valve seat; adjustable; sized for capacity equal to last step of compressor unloading; with solder-end connections.

### 2.03 REFRIGERANT PIPING SPECIALITIES

- A. Straight- or Angle-Type Strainers: 350-psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen of 80 to 100 mesh in liquid lines up to 1-1/8 inches, 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.
- B. Moisture/Liquid Indicators: 500-psig maximum working pressure and 200 deg F operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.
- C. Replaceable-Core Filter-Dryers: 500-psig maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:
- D. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.
- E. Permanent Filter-Dryer: 350-psig maximum operating pressure and 225 deg F maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

### 2.04 RECEIVERS

- A. Receivers, 6-Inch Diameter and Smaller: ARI 495, UL listed, steel, brazed, 400-psig pressure rating, with tappings as indicated on the drawings.
- B. Receivers Larger Than 6-Inch Diameter: ARI 495, welded steel, tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII; 400-psig pressure rating, with tappings as indicated on the drawings.

## 2.05 REFRIGERANTS

- A. ASHRAE 34, R-123: Dichlorotrifluoroethane.
- B. ASHRAE 34, R-134a: Tetrafluoroethane.
- C. ASHRAE 34, R-22: Monochlorodifluoromethane.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Built-up Systems: Install all piping, equipment, and components shown on the drawings. Unless specified otherwise on the drawings, provide and install piping and components to meet the equipment manufacturer's requirements and the requirements of this specification.
- B. Packaged Split Systems: Install all piping and components required and recommended by the equipment manufacturer to ensure proper operation and compliance with warranties of connected equipment. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, slopes of runs, required controls, and pipe and tube sizes. When piping and components are recommended but not supplied by the manufacturer, provide piping and components to meet the requirements of this specification. As a minimum, the following components shall be installed on systems of nominal 20 tons and larger;
  - C. Liquid Line Components: Replaceable core filter dryer, isolation valves for the filter dryer, access port for charging (service valves), solenoid valve, moisture indicating site glass, and expansion valves.
  - D. Suction Line Components: Replaceable core filter, access port (service valves), isolation valves for the filter.
  - E. Provide isolation valves at the condenser to isolate the refrigerant charge during maintenance.
  - F. Installation shall conform to ANSI 31.5, Refrigeration Piping and ASHRAE 15, Safety Code for Mechanical Refrigeration.

### 3.02 COORDINATION

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.

- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Section 07270, "Firestop and Smokestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
- E. Coordinate pipe fitting pressure classes with products specified in related Sections.

3.03 SYSTEM DESIGN PRESSURES

- A. Select pipe, fittings, and components that have design pressure ratings per ASHRAE 15 but not less than the following system design pressures:

	Low Side (psig)	High Side (psig)
R-22 (Air Cooled)	185	325
R-22 (Water Cooled)	185	250
R-134 (Air Cooled)	115	225
R-134 (Water Cooled)	115	160

3.04 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Section 15050, "Basic Mechanical Materials and Methods."
- B. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings. Piping shall be installed parallel with the building lines unless otherwise noted, with appropriate pitch free from traps.
- C. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing. Pipes shall be installed as to permit free expansion and contraction without damage to joints or hangers.
- D. When pre-charged, coiled tubing is furnished with split system, the excess tubing shall be coiled and placed out of view.
- E. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection. Installed piping shall not interfere with the operation or accessibility of doors or windows and shall not encroach on aisles, passageways, and equipment.
- F. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- G. Pipe shall be provided with capped or plugged ends when shipped and as erected, to prevent contaminating the system.

- H. When gauges are shown on the drawings, the Contractor shall install appropriately ranged continuous duty temperature and pressure gauges designed for refrigeration service. Pressure gauges shall be installed to sense compressor suction and discharge pressures. Connect pressure gauges to the system using service valves. Suction and liquid lines shall be insulated per Section 15083, "Pipe and Equipment Insulation". Hot gas lines shall not be insulated.
- I. All pressure relief valves shall be installed with a 3-way dual shut-off valve and a second relief valve, in parallel.
- J. Discharge from pressure relief valves shall be piped full size and extended to the outside of the building structure not less than 15 feet above adjacent grade and not less than 20 feet from any window , ventilation opening or exit.
- K. On built-up systems and packaged systems 20 tons and over, the contractor shall initially install a type "HH" filter drier to remove start-up contaminates. Final filter drier shall be installed after refrigeration system has been charged and has been in continuous operation for one week.
- L. Oil Return: Manufacturers specifications shall be followed for oil return on risers of 20 ft. or more (i.e., oil separators, p-traps or inverted p-traps).
- M. On built-up systems, install flexible connectors at or near compressors.

3.05 HANGERS AND ANCHORS:

- A. All piping shall be rigidly supported from the building structure by means of adjustable ring-type hangers. (WELDING TO BUILDING STRUCTURE WILL NOT BE PERMITTED.) Unistrut type trapeze hangers shall be used where pipes run side by side. Hanger spacing shall be as follows:

Horizontal:

<u>Copper Piping</u>	<u>Maximum Spacing</u>
3/8" and under	4'-0"
1/2" through 3/4"	6'-0"
1" through 1-1/2"	8'-0"
2" and larger	10'-0"

Vertical: Copper piping shall be supported at 10 feet intervals maximum.

- B. Round rods supporting the pipe hangers shall be of the following dimensions:

2" pipe and under	3/8" rod
2-1/2" to 3" pipe	1/2" rod

- C. Rods for trapeze hangers shall be a minimum of 3/8" and shall have the equivalent cross section listed above per pipe supported. The use of pipe hooks, chains, perforated iron strapping or wire for pipe supports WILL NOT be permitted.
- D. Insulated pipes shall be protected using galvanized steel shield similar to Grinnel Figure 167 or 360 galvanized steel shield by Pipe Shields Incorporated.
- E. Hanger rods shall be carbon steel per ASTM A307, Grade B, threaded per ANSI B1.1 coarse thread series, Class 2A fit. Hanger rods shall have minimum 6" threaded ends.
- F. Place a hanger within 1'-0" of each side for each horizontal elbow.
- G. Use hangers which are vertically adjustable 1-1/2" minimum after piping is erected.
- H. Use plastic coated straps on copper pipe.
- I. Soft copper tubing where permitted shall be fastened to the building structure with Unistrut type clamps and Unicushion inserts. Clamps shall not be spaced greater than 4'-0" apart.

### 3.06 BRAZED JOINTS:

- A. 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. Joints shall be cool before reassembling valve.
- B. Tubing shall be cut square, reamed, and burrs removed.
- C. Both inside of fittings and outside of tubing shall be well cleaned with an abrasive cloth or stainless-steel wire brush before brazing. Steel wool is NOT permitted.
- D. During brazing an inert gas (such as dry nitrogen, argon) shall be continuously passed through the system at a flow rate sufficient to maintain an oxygen-free environment to prevent the formation of copper oxide scale.
- E. Care shall be taken to prevent annealing of fittings and tubing when making connections.
- F. Copper to copper joints shall be brazed with a copper-phosphorous brazing alloy containing a minimum of 15% silver and conforming to AWS A5.8, BCuP5.
- G. Copper to brass joints shall be brazed with a silver brazing alloy containing a minimum of 50% silver and conforms to AWS 5.8, BAg-7.
- H. Copper to stainless steel joints shall be brazed with a silver brazing alloy containing a minimum of 50% silver and conforms to AWS 5.8, BAg-7.
- I. All brazed joints shall be cleaned to remove residual flux.

### 3.07 LEAK TESTING OF REFRIGERATION PIPING SYSTEMS

- A. The highside and lowside of each completed refrigeration piping system shall be pressure tested at a pressure not less than the lower of the system design pressure (See Section 3.02) or the setting of the pressure relief device protecting the highside or lowside of the system

Exception: Field installed systems with copper tubing not exceeding 0.625" O.D., shall be tested by means of refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68°F minimum.

The testing media shall be dry nitrogen. The contractor shall perform the leak test before insulating, evacuating and charging, in the presence of the Sandia Delegated Representative.

Isolate the compressor from the leak test by firmly closing the suction and discharge valves.

Where pressure relief valves are installed, position the three-way dual shut-off valves so that full test pressure is applied to both relief valves.

Do not attempt to repair any leak while the system is pressurized. If any leaks are found, relieve the test pressure and perform repairs.

Recharge the system, as previously described, and allow it to remain under pressure for 24 hours. Maximum pressure drop shall be 5 psig in 24 hours, at constant ambient temperature. For every 10oF drop in ambient temperature, from start of test, the maximum pressure drop may increase by 3 psig.

### 3.08 EVACUATION AND CHARGING

- A. After completion of the piping pressure test, the refrigeration system shall be evacuated and dehydrated with a vacuum pump. The following procedure shall be used unless otherwise noted:

Connect to the system, an accurate high vacuum gauge with a range of 0 - 1000 microns Hg.

Connect the vacuum pump to both the high and low side of the system. Leave the compressor suction and discharge service valves closed. Start the vacuum pump.

Keep ambient air temperatures above 60°F during the evacuation process.

Operate the vacuum pump until the system is evacuated to 500 microns Hg.

Break the system vacuum with dry nitrogen. Open the compressor suction and discharge service valves and re-evacuate the system to 500 microns Hg.

After the system has been twice evacuated to 500 microns Hg, close the vacuum pump suction valve and stop the pump. Allow the system to stand under a vacuum

a minimum of 12 hours. If no rise in pressure has taken place after 12 hours, the system may be charged. This test shall be made in the presence of the SDR.

The Contractor shall furnish and install full charge of refrigerant required to develop the system to its full rating. Also, during the warranty period, the contractor shall replace, without cost, all refrigerant lost due to equipment failure or system leaks. Refrigerant type and charge shall be as listed on equipment nameplate.

The Contractor shall provide the initial charge of lubricating oil for all refrigeration equipment and related apparatus.

After the refrigeration system has been charged and has been in continuous operation for one week, the contractor shall replace the initial type "HH" filter drier with the final filter dryer.

### 3.09 VIBRATION ISOLATION

- A. Rotating and reciprocating equipment shall be mounted on spring supported vibration isolating bases.
- B. Vibration isolation shall be per Section 15200, "Vibration Limits and Control".

### 3.10 TEST AND BALANCE

- A. The entire refrigeration system, including all control systems shall be operational and proven in the presence of the Sandia Delegated Representative before the Contractor may request SNL furnished Test and Balance service.

### 3.11 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements if required.
- B. Adjust high- and low-pressure switch settings to maintain a stable operating refrigeration system.
- C. Adjust set-point temperature of the conditioned air or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, follow all manufacturer's written instructions:
  - 1. Open shutoff valves in condenser water circuit.
  - 2. Check compressor oil level for proper charge.
  - 3. Open compressor suction and discharge valves.

4. Open refrigerant valves, except bypass valves that are used for other purposes.
5. Check compressor-motor alignment, and lubricate motors and bearings.

END OF SECTION 15183