

Specification Section 15183 Refrigerant Systems

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Part 1 - General

1.01 Summary

- A. Materials and operations required for installing 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 must be performed by Sandia National Laboratories (SNL) personnel only. The Contractor must schedule such work through the Sandia Construction Observer (SCO).

1.02 References

The current editions of the following standards are part of this specification:

A. SNL Construction Standard Specifications

Number	Title
Section 01330	Submittal Procedures
Section 07270	Firestopping
Section 09900	Painting
Section 13943	Facilities Control System
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

B. American Society of Mechanical Engineers Standards and American National Standards Institute (ASME/ANSI)

Number	Title
ANSI B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ANSI B31.5	Refrigeration Piping and Heat Transfer Components
ASME Section VIII	Boiler and Pressure Vessel Code - Unfired Pressure Vessels

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

- ANSI/ASHRAE 15 Safety Standard for Refrigeration Systems

D. American Society for Testing and Materials (ASTM)

- ASTM B280 Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service

E. American Welding Society (AWS)

- AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding

1.03 Submittals

- A. All required submittals must conform to Specification 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.
- D. Provide a copy of the current welding and brazing certification for all workers engaged in welding and brazing refrigerant piping.
- E. Provide a copy of the New Mexico Journeyman refrigeration license or other certificate of competence that indicates training and experience in the safe handling of refrigerants for workers engaged in pressure and vacuum testing. If the system being serviced uses R410 or R407C, then the training documentation should indicate specific training for these two refrigerants.

1.04 Quality Assurance

- A. ASHRAE Standard: Comply with ANSI/ASHRAE 15, *Safety Standard for Refrigeration Systems*.
- B. 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 (Air-Conditioning and Refrigeration), clean, dry, and capped

B. Annealed-Temper Copper Tube

- ASTM B 280, Type ACR, clean, dry, and capped. Annealed copper tubing must not be used for piping with an outside diameter (O.D.) larger than 0.625".

C. Wrought-Copper Fittings

- ASME B16.22

D. Bronze Filler Metals

- AWS A5.8, Classification BAg-7 (50% silver), BCuP-5 (15% silver)

2.02 Valves

Select pipe, fittings, and components that have design pressure ratings per ASHRAE 15 but not less than the test pressures indicated in Section 3.03.

A. Lines 1" O.D. or Smaller

- Diaphragm Packless Valves: Globe design with straight-through or angled pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and solder-end connections.

B. Lines 1-1/8" O.D. or Larger

- Wing Cap Packed Valves: Straight-through or angled pattern, forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and solder-end connections.

C. Check Valves Smaller than Nominal Pipe Size (NPS) 1

- Cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve must have a straight-through pattern and solder-end connections.

D. Check Valves NPS 1 and Larger

- Cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve must have a straight-through or angled pattern and solder-end connections.

E. Service Valves

- Forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and solder-end connections.

F. Three-way dual shutoff valves for use with pressure-relief valves. Henry Type 92.

G. Solenoid Valves

- Comply with ARI (Air-Conditioning and Refrigeration Institute) 760; forged brass, with polytetrafluoroethylene valve seat, two-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA (National Electrical Manufacturers Association) 250 enclosure of type required by location, with 1/2" conduit adapter, and voltage and normal holding coil position as indicated on the drawings.

H. Pressure-Relief Valves

- Straight-through or angled pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting. Valves must 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 fewer 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 Specialties

Select pipe, fittings, and components that have design pressure ratings per ASHRAE 15 but not less than the test pressures indicated in Section 3.03.

- A. Straight- or Angle-Type Strainers:** 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", 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.
- B. Moisture/Liquid Indicators:** All-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.
- C. Replaceable-Core Filter-Dryers:** Heavy gauge 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:

1. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730–rated for capacity.
2. Permanent Filter-Dryer: Steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

2.04 Receivers

A. Receivers Smaller than 6" Diameter

- ARI 495, Underwriters Laboratories (UL) listed, steel, brazed, 400 pounds per square inch gauge (psig) pressure rating, with tapings as indicated on the drawings.

B. Receivers Larger than 6" Diameter

- ARI 495, welded steel, tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII; 400 psig pressure rating, with tapings as indicated on the drawings.

2.05 Refrigerants

- A. ASHRAE 34, R-123: (HCFC) Dichlorotrifluoroethane
- B. ASHRAE 34, R-134A: Tetrafluoroethane
- C. ASHRAE 34, R-22: (HCFC) Monochlorodifluoromethane
- D. ASHRAE 34, R-410A: (HFC) Pentafluoroethane/Difluoromethane
- E. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane

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 must be installed on systems of nominal 20 tons and larger:
 1. 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.
 2. Suction Line Components: Replaceable-core filter, access port (service valves), isolation valves for the filter.

C. Provide isolation valves at the condenser to isolate the refrigerant charge during maintenance.

D. Installation must conform to ASME B31.5, *Refrigeration Piping*, and ANSI/ASHRAE 15, *Safety Standard for Refrigeration Systems*.

3.02 Coordinating Installations

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC (heating, ventilating, and air-conditioning) 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 Specification Section 07270, *Firestopping*, 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 Selecting System Design Test Pressures

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

Type	Low Side (psig)	High Side (psig)
R-22 (Air Cooled)	185	325
R-22 (Water Cooled)	185	250
R-134A (Air Cooled)	115	225
R-134A (Water Cooled)	115	160
R-407C (Air Cooled)	230	380
R-407C (Water Cooled)	230	285
R-410A (Air Cooled)	300	535
R-410A (Water Cooled)	300	400

3.04 Installing Piping

Basic piping installation requirements are specified in Specification Section 15050, *Basic Mechanical Materials and Methods*.

- A. Install piping to be as short and direct as possible, with a minimum number of joints, elbows, and fittings. Piping must be installed parallel to the building lines unless otherwise noted, with appropriate pitch free from traps.
- B. Pipe must be cut accurately to measurements established at the construction site and must be worked into place without springing or forcing. Pipes must be installed as to permit free expansion and contraction without damage to joints or hangers.
- C. When precharged, coiled tubing is furnished with a split system, the excess tubing must be coiled and placed out of view.
- D. 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 must not interfere with the operation or accessibility of doors or windows and must not encroach on aisles, passageways, and equipment.
- E. 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.
- F. To prevent contaminating the system, pipe must be provided with capped or plugged ends when shipped and as erected.
- G. When gauges are shown on the drawings, the Contractor must install appropriately ranged continuous-duty temperature and pressure gauges designed for refrigeration service. Pressure gauges must be installed to sense compressor suction and discharge pressures. Connect pressure gauges to the system using service valves. Suction and liquid lines must be insulated per Specification Section 15083, *Pipe and Equipment Insulation*. Hot-gas lines must not be insulated.

1. All pressure-relief valves must be installed with a three-way dual shutoff valve and a second relief valve in parallel.
 2. Discharge from pressure-relief valves must be piped full size and extended to the outside of the building structure not less than 15' above adjacent grade and no fewer than 20' from any window, ventilation opening, or exit.
- H. On built-up systems and packaged systems 20 tons and over, the Contractor must initially install a type "HH" filter-dryer to remove start-up contaminants. Final filter-dryer must be installed after the refrigeration system has been charged and has been in continuous operation for one week.
- I. Oil Return: Manufacturers specifications must be followed for oil return on risers of 20' or more (for example, oil separators, p-traps or inverted p-traps).
- J. On built-up systems, install flexible connectors at or near compressors.

3.05 Installing Hangers and Anchors

- A. All piping must be rigidly supported from the building structure by means of adjustable ring-type hangers. (Welding to building structure will not be permitted.) Unistrut® trapeze-type hangers must be used where pipes run side by side. Hanger spacing must be as follows:

- Horizontal:

Copper Piping	Maximum Spacing
3/8" and smaller	4'-0"
1/2" through 3/4"	6'-0"
1" through 1-1/2"	8'-0"
2" and larger	10'-0"

- B. Copper piping must be supported at 10' intervals maximum. Round rods supporting the pipe hangers must be of the following dimensions:

- Vertical:

Pipe Size	Rod Size
2" pipe and smaller	3/8" rod
2-1/2" to 3" pipe	1/2" rod

- C. Rods for trapeze hangers must be a minimum of 3/8" and must have the equivalent cross section listed above for each pipe supported. The use of pipe hooks, chains, perforated iron strapping, or wire for pipe supports is not permitted.
- D. Insulated pipes must be protected with a galvanized-steel shield similar to Grinnell Figure 167, or Piping Technology and Products Fig. 183.
- E. Hanger rods must be carbon steel per ASTM A307, Grade B, and threaded per ANSI B1.1 coarse thread series, Class 2A fit. Hanger rods must have minimum 6" threaded ends.
- F. Place a hanger within 1'-0" of each side for each horizontal elbow.

- G. Use hangers that are vertically adjustable 1-1/2" minimum after piping is erected.
- H. Use plastic coated straps on copper pipe.
 - Soft copper tubing, where permitted, must be fastened to the building structure with Unistrut-type clamps and Unicushion[®] inserts. Clamps must not be spaced greater than 4'-0" apart.

3.06 Brazing Joints

- A. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb. Joints must be cool before reassembling valve.
- B. Tubing must be cut square, reamed, and have burrs removed.
- C. The inside of fittings and outside of tubing must 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 or argon) must be passed through the system continuously at a flow rate sufficient for maintaining an oxygen-free environment to prevent the formation of copper oxide scale.
- E. Take care to prevent damage to fittings and tubing caused by overheating when making connections.
- F. Copper-to-copper joints must be brazed with a copper-phosphorous brazing alloy containing a minimum of 15% silver and conforming to AWS A5.8, BCuP-5.
- G. Copper-to-brass joints must be brazed with a silver brazing alloy containing a minimum of 50% silver and conforming to AWS 5.8, BA_g-7.
- H. Copper-to-stainless-steel joints must be brazed with a silver brazing alloy containing a minimum of 50% silver and conforming to AWS 5.8, BA_g-7.
 - All brazed joints must be cleaned to remove residual flux.

3.07 Testing Refrigeration Piping Systems for Leaks

- A. The high side and low side of each completed refrigeration piping system must be pressure tested at a pressure not less than the lower of the system test pressure (see Section 3.03) or the setting of the pressure-relief device protecting the high side or low side of the system.
 - Exception: Field-installed systems with copper tubing not exceeding 0.625" O.D. must be tested by means of refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68°F minimum.
- B. The testing media must be dry nitrogen. The Contractor must perform the leak test in the presence of the Sandia Delegated Representative (SDR) before insulating, evacuating, and charging.
- C. Isolate the compressor from the leak test by firmly closing the suction and discharge valves.

- D. Where pressure-relief valves are installed, position the three-way dual shutoff valves so that full test pressure is applied to both relief valves.
- E. Do not attempt to repair any leak while the system is pressurized. If any leaks are found, relieve the test pressure and perform repairs.
- F. Recharge the system, as previously described, and allow it to remain under pressure for 24 hours. Maximum pressure drop is 5 psig in 24 hours at constant ambient temperature. For every 10°F drop in ambient temperature from start of test, the maximum pressure drop may increase by 3 psig.

3.08 Evacuating and Charging

- A. After the piping pressure test is complete, the refrigeration system must be evacuated and dehydrated with a vacuum pump. The following procedure must be used unless otherwise noted:
 - 1. Connect an accurate, high-vacuum gauge with a range of 0–1,000 microns Hg to the system.
 - 2. 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.
 - 3. Ambient air temperatures must be above 60°F during the evacuation process. (During cold times of the year, it may be necessary to construct a temporary enclosure with heat added to maintain the 60°F or higher temperature for the duration of the evacuation and charging period.)
 - 4. Operate the vacuum pump until the system is evacuated to 500 microns Hg.
 - 5. Break the system vacuum with dry nitrogen. Open the compressor suction and discharge service valves, and reevacuate the system to 500 microns Hg.
 - 6. 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 four hours. If no rise in pressure has occurred after four hours, the system may be charged. This test must be done in the presence of the SDR and documented.
- B. The Contractor must furnish and install the full charge of refrigerant required to develop the system to its full rating. Also, during the warranty period, the Contractor must replace, without cost, all refrigerant lost because of equipment failure or system leaks. Refrigerant type and charge must be as listed on the equipment nameplate.
- C. The Contractor must provide the initial charge of lubricating oil for all refrigeration equipment and related apparatus.
- D. After the refrigeration system has been charged and has been in continuous operation for one week, the Contractor must replace the initial type "HH" filter-dryer with the final filter-dryer.

3.09 Isolating Vibration

- A. Rotating and reciprocating equipment must be mounted on spring-supported vibration-isolating bases.
- B. Vibration isolation must conform to Specification Section 15200, *Vibration Limits and Control*.

3.10 Requesting Test and Balance Service

The entire refrigeration system, including all control systems, must be operational and proven in the presence of the SDR 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, and 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