

**SUPERSEDED**

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**STANDARD SPECIFICATION**

**SECTION 15651**

**REFRIGERATION SYSTEMS**

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# **SUPERSEDED**

## **STANDARD SPECIFICATION**

### **SECTION 15651**

#### **REFRIGERATION SYSTEMS**

##### **PART 1 - GENERAL**

###### **1.01 WORK INCLUDED**

Materials and operations required for the installation of reciprocating and packaged refrigeration systems, including piping, fittings, equipment, refrigeration accessories, refrigerants and lubricating oil, joints, testing, evacuation and charging, and vibration isolators.

###### **1.02 QUALITY ASSURANCE**

Brazing and Soldering: Shall conform to ANSI/ASME B31.5, Refrigeration Piping Section 528.

###### **1.03 REFERENCES**

The current editions of the following standards are a part of this specification.

###### **A. Sandia National Laboratories Standard Specifications:**

Section 01300	Descriptive Submittals
Section 09900	Painting
Section 15050	General Materials and Work Requirements
Section 15200	Vibration Isolation
Section 15250	Insulation - Mechanical Systems

- B. 1. ANSI B1.1 Unified Screw Threads
2. ANSI B16.18 Cast Copper alloy Solder-Joint Pressure Fittings
3. ANSI B16.22 Wrought Copper and Copper Alloy Solder-joint Pressure Fittings
4. ANSI B31.5 Refrigeration Piping
- C. ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration
- D. ARI Guideline Containers for Recovered Fluorocarbon Refrigerants  
K-1990

## **SUPERSEDED**

- E. ASME Boiler and Pressure Vessel Code
- F. 1. ASTM A307 Carbon Steel Bolts and Studs, 60,000 psi tensile strength.  
2. ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration field service.
- G. AWS A5.8-89 Specification for Brazing Filler Metal
- H. UMC Uniform Mechanical Code

### 1.04 SUBMITTALS

- A. All required submittals shall be per Section 01300.
- B. All pipe materials, equipment and refrigeration accessories shall be submitted for approval.
- C. If Chlorofluorocarbon (CFC) reclamation is required (See Paragraph 3.04), submit:
  - 1. Type and certification of recovery equipment.
  - 2. Documentation that provides the following CFC disposal information:
    - a. Date of disposal.
    - b. Where and how the CFC has been disposed.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

The companys mentioned in the following Sections are of acceptable type, quality, and performance.

### 2.02 PIPING MATERIALS

Piping materials shall be as follows unless otherwise indicated on the applicable contract drawings.

- A. Pipe: Shall be type "ACR" copper tubing, ASTM B280 or as specified in ANSI B31.5, Section 523. Soft annealed copper tubing shall not be used for piping larger than 1/2" O.D.
- B. Fittings: Shall be long radius, wrought copper with brazed or solder joints, ANSI B16.22/ANSI 16.18.

## **SUPERSEDED**

### 2.03 HANGERS AND ANCHORS

1. Single pipe, hangers shall be an adjustable ring type, plastic coated or with cushion insert and have a minimum vertical adjustment of 1-1/2", after piping has been erected.
2. Multi-pipe, hangers shall be a Unistrut type trapeze with clamps containing a Unicushion (flexible elastomer) insert.
3. 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. The use of pipe hooks, chains, perforated iron strapping or wire for pipe supports WILL NOT be permitted.

### 2.04 EQUIPMENT

All major items of equipment shall be as specified in the equipment schedules on the drawings and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory operating system.

### 2.05 REFRIGERANT TYPE

The system refrigerant shall be Hydrochlorofluorocarbon-22 (HCFC-22). CFC's are not allowed.

### 2.06 REFRIGERATION ACCESSORIES

#### A. Manual Shut-off Valves:

1. Lines 1"OD or smaller: Shall be of the diaphragm packless type; Mueller (Linemaster, Globemaster), Henry (Golden Bantam) or Henry refrigeration service ball valve.
2. Lines 1-1/8"OD or larger: Shall be wing cap packed bronze valves with bolted bonnets, back seating type, repackable under pressure; Mueller (Linemaster, Globemaster), Henry (Golden Bantam) or Henry refrigeration service ball valve.
3. Three-way dual shut-off valves shall be used with pressure relief valves; Henry series 8000.

#### B. Expansion Valves:

1. Shall be of the thermostatic types as manufactured by Alco or Sporlan and shall be gas charged with capillary type external superheat adjustment and external equalizing connection.
2. Capillary tubes are only allowed in packaged units, less than 10 tons.

## SUPERSEDED

3. Each type shall be designed to meter liquid equally to all distributing tubes, and shall be properly sized for the refrigerant used and the capacity required.

### C. Liquid Line Strainers:

1. Each expansion valve shall be protected by a strainer in the refrigerant liquid line.
2. The strainer shall be as manufactured by the Henry Valve Co. (800 Series), not less than line size and installed with isolation valves.

### D. Solenoid Valves:

1. Solenoid valves shall be suitable for the system in which they are used and designed specifically for use with the particular refrigerant.
2. Valves shall be Alco, Skinner, or Sporlan.

### E. Filter Driers:

Each liquid line, within the refrigeration system, shall have a separate filter drier.

1. The filter drier shall be the replaceable cartridge type for a liquid line size of 3/4" O.D. and larger, or a nominal 12 ton and larger system. The filter drier shall be sized for compressor capacity.
  - a. Initial start-up/clean-up filter drier shall be a type "HH", for system clean-up; Sporlan, Henry or Mueller.
  - b. Final filter drier shall be a Sporlan ("Catch-All"), Henry ("Dri-Cor" Type 7-C, PA400), or Mueller ("Drymaster Micro-Guard") silica gel filter and drier.
2. Disposable filter driers are only allowed in systems with a liquid line size of 5/8" O.D. and smaller, or less than 12 nominal tons. Disposable filter driers shall be furnished with flared connections.
  - a. Initial start-up/clean-up filter drier shall be a type "HH", for system clean-up; Sporlan, Henry or Mueller.
  - b. Final filter drier shall be made by Sporlan, Henry, or Mueller.
3. Evacuation ports shall be provided and installed in a three valve bypass with the filter drier.

### F. Liquid Indicators:

Install a Henry (MI-31 series), Alco (AMI-1), Sporlan ("See All"), or Mueller ("Sightmaster" or "Vuemaster") liquid indicator with double ports and seal caps in each liquid line, downstream of the filter drier(s).

### G. Receivers:

## **SUPERSEDED**

1. Receivers shall be constructed and tested in accordance with requirements of Section VIII of the ASME Boiler and Pressure Vessel Code and shall be National Board registered (See Section 15050).
  2. Receivers shall be equipped with inlet, outlet drop pipe, drain plug, purging valve, pressure relief valve, isolation valves, liquid level indicator, and shall have a storage capacity not less than 25 percent in excess of that required for the fully charged system.
- H. Pressure Relief Devices:
1. Shall conform to Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15, and Section VIII, Division I of the ASME Boiler and Pressure Vessel Code. The valves shall be factory set to maintain an operating or standby pressure not to exceed the receiver maximum allowable working pressure (MAWP), per UMC chapter 15.
  2. Relief valves shall be Mueller (Safetymaster) or Henry (Series 600 or 6000).
- I. Charging and Purging Valves:
1. Shall be the diaphragm packless type forged brass with positive back seating. Flare connection shall have seal cap with copper gasket chained to valve body.
  2. Valves shall be Henry (6000 series) or equal.
- J. Low Ambient Controls:
1. Low ambient head pressure control shall be provided, to 0<sup>o</sup> F, on all air cooled condensers.
- K. Gauges:
1. Pressure gauges shall be compound gauges, 4-1/2" dial size, 30"Hg vac/0/150psig range, Ashcroft 1009A-XR3 for HCFC-22 service.
  2. Temperature gauges shall be remote mounted vapor type thermometers, 4-1/2" dial size, -40<sup>o</sup>F to 100<sup>o</sup>F range, Ashcroft 6140 for HCFC-22 service.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. General:
1. Installation shall conform with the American National Standard Code, ANSI B31.5, Refrigeration Piping.
  2. Installed piping shall not interfere with the operation or accessibility of doors or windows; shall not encroach on aisles, passageways, and equipment; and shall not interfere with the servicing or maintenance of equipment.

## SUPERSEDED

3. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment.
4. Cutting or weakening of structural members to facilitate piping installation is not permitted.
5. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangars.
6. Piping shall be installed parallel with the building lines unless otherwise noted, with appropriate pitch free from traps, and shall be provided with capped or plugged ends, when shipped and as it is erected, to prevent contaminating the system.
7. 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 throttling valves. The suction connection from each coil shall be provided with a test thermometer well in the pipe for adjustment of the thermostatic expansion valves.
8. Suction lines shall be insulated. Liquid lines do not require insulation. Hot gas lines shall not be insulated.
9. All pressure relief valves shall be installed with a 3-way dual shut-off valve and a second relief valve, in parallel.
10. Discharge from pressure relief valves shall be piped full size and extended to the outside of the building structure, unless otherwise shown on the drawings.
11. Contractor shall initially install a type "HH" filter drier to remove start-up contaminants. Final filter drier (see 2.04E) shall be installed after refrigeration system has been charged and has been in continuous operation for one week.

### B. Hangers and Anchors:

1. 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:

#### a. 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"

#### b. Vertical:

Copper piping shall be supported at 10 feet intervals maximum.

## SUPERSEDED

2. 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

3. 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.
4. Insulated pipes shall be protected using galvanized steel shield similar to Grinnel Figure 167 or 360 galvanized steel shield by Pipe Shields Incorporated.
5. 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.
6. Place a hanger within 1'-0" of each side for each horizontal elbow.
7. Use hangers which are vertically adjustable 1-1/2" minimum after piping is erected.
8. Use plastic coated straps on copper pipe.
9. Soft copper tubing where permitted shall be fastened to the building structure with Unistrut type clamps and Unicushion inserts. Clamps shall not be spaced than 4'-0" apart.

### C. Brazed Joints:

1. Tubing shall be cut square, reamed, and burrs removed.
2. Both inside of fittings and outside of tubing shall be well cleaned with wire brush before sweating. Steel wool is NOT permitted.
3. Disassemble valves before brazing. Joints shall be cool before reassembling valve.
4. An inert gas (such as oil pumped dry nitrogen) shall be continuously passed through the copper piping when sweating joints to prevent formation of copper oxide.
5. Care shall be taken to prevent annealing of fittings and tubing when making connections.
6. Copper to copper joints shall be brazed with a copper-phosphorous brazing alloy containing a minimum of 15% silver and conforming to AWS A5.8-89, BCuP5.
7. Copper to brass joints shall be brazed with a silver brazing alloy containing a minimum of 50% silver and conforms to AWS 5.8-89, BAg-7.
8. Copper to stainless steel joints shall be brazed with a silver brazing alloy containing a minimum of 50% silver and conforms to AWS 5.8-89, BAg-7.

## **SUPERSEDED**

9. All brazed joints shall be cleaned to remove residual flux.

D. Oil Return:

Manufacturers specifications shall be followed for oil return on risers of 20 ft. or more (i.e., oil separators, p-traps and inverted p-traps).

### 3.02 LEAK TESTING OF REFRIGERATION PIPING SYSTEMS

- A. The completed refrigeration piping system shall be tested by the halide electronic leak detector method at 150 psig.
- B. The testing media shall be a 10 psig charge of HCFC-22 plus the oil pumped dry nitrogen. The leak test shall be performed by the contractor, before insulating, evacuating and charging, in the presence of the Sandia Delegated Representative. The leak test media, apparatus and tester shall be furnished by the Contractor.
- 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 shut-off 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 shall be 5 psig in 24 hours, at constant ambient temperature. For every 10<sup>0</sup>F drop in ambient temperature, from start of test, the maximum pressure drop may increase by 3 psig.

### 3.03 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:
  - 1. Connect to the system, an accurate high vacuum gauge with a range of 0 - 1000 microns Hg (as made by Stokes).
  - 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. Keep ambient air temperatures above 60<sup>0</sup>F during the evacuation process.
  - 4. Operate the vacuum pump until the system is evacuated to 500 microns Hg.
  - 5. Break the system vacuum with oil pumped dry nitrogen. Open the compressor suction and discharge service valves and reevacuate the system to 500 microns Hg.

## **SUPERSEDED**

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 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.
- B. The Contractor shall furnish and install all of the 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 name plate.
- C. The Contractor shall 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 shall replace the initial type "HH" filter drier with the final filter drier (see 2.04E).

### 3.04 CHLOROFLUOROCARBON (CFC) RECLAMATION

- A. The Contractor shall capture and reclaim all CFC's that may be part of an existing system being modified or replaced. CFC's SHALL NOT be vented to atmosphere.
  1. Recovery equipment shall have current certification by Air Conditioning and Refrigeration Institute (ARI) or Food Marketing Institute (FMI).
  2. The receiver(s) shall be refillable (disposable containers will not be allowed) and shall meet the qualification outline in ARI Guideline K-1990.
  3. Use low-permeation rate hoses equipped with automatic shut-off valves. Keep refrigerant contained and air out.
  4. Connect a vacuum pump to the recovery equipment and run a leak check. Operate the vacuum pump until the system has been evacuated to 500 microns. If no rise in pressure occurs in 1 hour, then the reclamation may proceed. If, after 1 hour, there is a rise in pressure, repair all leaks. Then follow the equipment manufacturer's recovery instructions.
- B. Submit documentation certifying that the CFC has been properly disposed.

### 3.05 VIBRATION ISOLATION

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

### 3.06 TEST AND BALANCE

## **SUPERSEDED**

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.

END OF SECTION