
USACE / NAVFAC / AFCEA / NASA UFGS-23 23 16.00 40 (April 2006)

Preparing Activity: NASA Superseding
NASA-15185S (December 2005)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are NOT in agreement with UMRL dated 01 April 2006

Revised throughout - changes not indicated by CHG tags

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SECTION 23 23 16.00 40

REFRIGERATION PIPING AND SPECIALTIES 04/06

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers only the piping and specialties used for gases normally used in air-conditioning systems applications.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's

Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 495 (2005) Standard for Refrigerant Liquid Receivers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 (2004) Safety Code for Refrigeration

ASHRAE-04 (2005) Handbook, Fundamentals (SI Edition)

ASHRAE-05 (2003) Handbook, HVAC Applications (SI Edition)

ASHRAE-06 (2004) Handbook, HVAC Systems and Equipment (IP Edition)

ASHRAE-07 (2004) Handbook, HVAC Systems and Equipment (SI Edition)

ASHRAE-08 (2002) Handbook, Refrigeration (SI Edition)

ASME INTERNATIONAL (ASME)

ASME B16.22 (2001) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B31.5 (2001) Refrigeration Piping and Heat Transfer Components

ASME B40.1 (1998) Pressure Gauges and Gauge Attachments

ASME BPVC SEC VIII D1 (2004) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A 278/A 278M (2001) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 degrees F (350 degrees C)

ASTM B 280 (2003) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM B 62 (2002) Standard Specification for Composition Bronze or Ounce Metal Castings

ASTM F 104 (2003) Standard Classification System for Nonmetallic Gasket Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-104 (2003) Standard for Wrought Copper Solder Joint Pressure Fittings

MSS SP-86 (2002) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J513 (1999) Refrigeration Tube Fittings - General Specifications

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-F-1183 (1987j) Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specification for

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS BB-N-411 (2002c) Nitrogen, Technical

1.2 GENERAL REQUIREMENTS

NOTE: If Section 23 00 00.00 40 GENERAL MECHANICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 23 00 00.00 40 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

Record Drawings shall be submitted for refrigeration piping systems providing current factual information including deviations from, and amendments to, the drawings and concealed and visible changes in the work.

Fabrication drawings shall be submitted for Refrigeration Piping and Accessories showing fabrication details to be performed in the shop prior to installation.

System Analysis Development Data shall be submitted showing data on accumulative operating probabilities, such as impact of accumulative tolerances on performance of the refrigeration piping system. Logic diagrams shall indicate the probability of unbalance on a system if

out-of-tolerance power exists. Logic data shall depict possible failure modes, probable failure rates, and detailed system level analysis.

1.3 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all gages and regulators.

Refrigerant
Refrigerant Liquid Receiver
Pressure Gages
Thermometers
Valves
Regulators
Filter/Dryers

Liquid Sight Glasses
Moisture Indicators
Discharge-Line Oil Separator
Liquid-Suction Interchangers
Line Strainers

Fabrication drawings shall be submitted for the following in accordance with paragraph entitled, "General Requirements," of this section.

Refrigeration Piping
Accessories

Installation drawings shall be submitted for refrigeration piping systems in accordance with the paragraph entitled, "Installation," of this section.

Record Drawings shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-03 Product Data

Equipment and performance data shall be submitted for the following items indicating use life, system functional flows, safety features, and features such as electrical system protective device ratings.

Pressure Gages
Thermometers
Valves
Regulators

Manufacturer's catalog data shall be submitted for the following items:

Refrigerant
Gaskets
Piping
Refrigerant Liquid Receiver
Filter/Dryers
Liquid Sight Glasses
Moisture Indicators
Discharge-Line Oil Separator
Liquid-Suction Interchangers
Line Strainers
Mufflers
Supports
Spare Parts

SD-05 Design Data

System Analysis Development Data shall be submitted for refrigeration piping system in accordance with paragraph entitled, "General Requirements," of this section.

SD-06 Test Reports

Test reports shall be submitted in accordance with the paragraph entitled, "Testing," of this section.

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Refrigerant
Gaskets
Piping
Refrigerant Liquid Receiver
Pressure Gages
Thermometers
Valves
Regulators
Filter/Dryers
Liquid Sight Glasses
Moisture Indicators
Discharge-Line Oil Separator
Liquid-Suction Interchangers
Line Strainers
Mufflers
Supports
Spare Parts

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.4 OPERATION AND MAINTENANCE

Contractor shall submit [6] [_____] copies of the Operation and Maintenance Manuals and Spare Parts requirements 30 calendar days prior to testing the refrigeration piping systems. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

PART 2 PRODUCTS

2.1 GENERAL

All system materials shall comply with applicable requirements of ASHRAE 15, ASHRAE-04, Chapter 35, ASHRAE-08 and ASME B31.5.

2.2 REFRIGERANT

Refrigerant shall have ozone depletion potential of [0.05] [_____] or less and shall conform to ASHRAE-07 ASHRAE-06, Chapter 32.

CFC refrigerant shall not be used.

2.3 PURGING AND TESTING NITROGEN GAS

Gaseous nitrogen shall be dry, conforming to FS BB-N-411, Grade A (99.95 percent pure), Type I (gaseous), with minus 57 degrees C minus 70-degree F dewpoint.

2.4 BRAZING ROD

Brazing material shall be AWS Type BCuP-5.

2.5 GASKETS

Gaskets shall be formed from compressed non-asbestos fiber material sheet conforming to [ASTM F 104](#), both sides shall be free of any lubricant and shall contain not less than 75 percent non-asbestos fiber material.

2.6 PIPING

Type CPR-ACR-Copper air-conditioning [Refrigeration Piping](#) shall be as follows:

Tubing:

To 22 millimeter outside diameter (od)	Annealed Type K, conforming to ASTM B 280 , where bending or flare connection is required
Over 22 millimeter (od)	Hard-drawn, seamless-copper tubing conforming to ASTM B 280 , No. C12200

Fittings:

To 22 millimeter (od)	Flared-type, conforming to SAE J513
Over 22 millimeter (od)	1050 kilopascal, wrought-copper socket-joint conforming to ASME B16.22 , MSS SP-104 , and MSS SP-86

All fitting cup depths and tolerances shall conform to [MS MIL-F-1183](#), and [MSS SP-86](#)

To 7/8-inch outside diameter (od)	Annealed Type K, conforming to ASTM B 280 , where bending or flare connection is required
Over 7/8-inch od	Hard-drawn, seamless-copper tubing conforming to ASTM B 280 , No. C12200

Fittings:

To 7/8-inch od	Flared-type, conforming to SAE J513
Over 7/8-inch od	150-pound per square inch, gage (psig), wrought-copper socket-joint, conforming to ASME B16.22

All fitting cup depths and tolerances shall conform to [MS MIL-F-1183](#).

NOTE: Select following text if expansion and vibration isolation provisions are not specifically

indicated. Refer to Section 23 05 48.00 40
VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT.

Flexible connectors:

All sizes: Flexible connections for reciprocating equipment shall be the seamless, corrugated, all nonferrous-metal type with external nonferrous metal reinforcing braid. Flexible connections shall be installed in pairs, one at right angle to the other, whether shown or not. Working pressure rating shall have 4 to 1 safety factor at minimum.

2.7 REFRIGERANT LIQUID RECEIVER

NOTE: The following covers remote receivers for process or comfort air-conditioning systems.

Delete receiver or provide bypass valving if subcooling is required or when head pressure control is used.

Drawings or schedule must show size, piping diagrams, etc.

Refrigerant liquid receiver shall have all necessary openings, accessories, and support provisions.

Receiver shall conform to ARI 495, ASHRAE-05, ASHRAE-08 and ASHRAE-06 and ASME BPVC SEC VIII D1.

Pump-down capacity of receiver shall be 80 percent of the internal volume of the receiver.

Receiver shall be equipped with inlet-outlet drop pipe, drain plug, purging valve, relief valves of capacity and setting required by ASHRAE 15, and two bull's-eye liquid-level sight glasses. Sight glasses shall be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 75 millimeter 3 inches horizontally from the drop pipe, measured along the axis of the receiver. In lieu of bull's-eye sight glass, external gage glass with metal glass guard and automatic-closing stop valves may be provided.

2.8 PRESSURE GAGES

Refrigerant pressure gages shall conform to requirements specified under Section 23 05 00.00 40 BASIC MECHANICAL MATERIALS AND METHODS except that gages shall be in conformance with ASME B40.1, Class 1, Style X, Type III, minimum 90 millimeter 3-1/2 inchsize.

2.9 THERMOMETERS

Thermometers shall conform to the requirements specified under Section 23 05 00.00 40BASIC MECHANICAL MATERIALS AND METHODS. Dial, remote or direct-bulb adjustable-angle type, is acceptable provided case is corrosion-resistant steel, not less than 90 millimeter 3-1/2 inches in diameter, and accuracy is plus or minus 0.5 degree 1 degree, graduated in

1-degree 2-degree increments. Dial face shall be white with black digits. Thermometers shall be installed in copper wells.

2.10 SHUTOFF AND CHECK VALVES

Valves shall conform to ASHRAE-05 ASHRAE-06, Chapter 42. Shutoff valves shall be packless diaphragm (in sizes commercially available), with packed, ground-finish stem, key operated, back seating, sealed-cap type; otherwise, angle pattern valves shall be used whenever possible. Check valves shall be lift type for gases and vapors and swing-check type for liquids.

Valves connected to copper tubing shall have flared end connections up to 22 millimeter 7/8-inch od and [socket type ends] [flanged ends] with flange adapters for all other sizes.

2.11 SOLENOID VALVES

Valves shall be brass or steel body, packless type, with corrosion-resistant steel trim, rated for continuous-duty service, direct-or pilot-operated, provided with manual lift stems, and designed for use with type of refrigerant used. Valve capacities shall be sufficient for the requirements of the installation at a pressure drop not in excess of 14 kilopascal 2 pounds per square inch (psi). Valves in suction lines shall be sized in accordance with temperature rise and superheat normal to the system.

Valves connected to copper tubing shall have flared-end connections up to 22 millimeter 7/8-inch od and [socket type ends] [flanged ends] with socket flange adapters for all other sizes.

2.12 EXPANSION VALVES

Valves shall be thermal-expansion type to suit specific system refrigerant, designed to fit coil distributors, and capable of operating from 40 to 100 percent of full load at system head pressure without hunting or liquid hammer. Valves shall have external equalizer connections and external superheat adjustments with seal caps. Joint connections shall be [mechanical threaded] [flanged type]. Valves shall require not over 2 degrees C 4 degrees F superheat change to move from fully open to fully closed position. Superheat setting shall be minus 12 degrees C 10 degrees F at full load.

Expansion valves shall be balanced [double-seated] [pilot-operated], capable of stable operation at 15 percent design load.

Each valve shall be provided with external strainer.

Manual-angle, globe body expansion valves shall be provided in three shutoff-valve bypasses to facilitate automatic valve maintenance.

2.13 EVAPORATOR PRESSURE REGULATORS

Evaporator pressure regulators shall have a maximum pressure drop at design conditions of 21 kilopascal 3 psi with refrigerants R-22 or R-502. Regulators shall be installed with valved gages upstream and downstream and shall be fully adjustable, both for setting and for throttling range from open to closed.

2.14 FILTER/DRYERS

Filter/dryers, in sizes 13 millimeter 1/2 inch and larger shall be the full-flow, replaceable-core type. Sizes smaller than 13 millimeter 1/2 inch shall be the sealed type. Cores shall be of a suitable desiccant that will not plug, cake, dust, channel, or break down but shall remove water, acid, and foreign material from the refrigerant. Dryer shall be constructed so that no desiccant will pass into the refrigerant lines. A filter/dryer shall be provided in the liquid line to each evaporator and shall be piped with a three-valve bypass. Pressure drop through the dryer shall not exceed 14 kilopascal 2 psi when operating at full connected evaporator capacity.

2.15 LIQUID SIGHT GLASSES

Sight glasses shall be double glass, see-through type, with cover cap on each side. Sight glass shall be provided in liquid line immediately preceding each expansion valve. Glass shall be furnished with a color-change-type moisture indicator.

2.16 MOISTURE INDICATORS

NOTE: Can be used on liquid lines, receivers,
access valves, tees, or unions, 6M 1/4-inch SAE
thread type may be provided with valve depressor to
open stem on access valve. Can be included in the
sight glass.

Color-change moisture indicators shall be [provided downstream from each filter/dryer and bypass] [combined as a single unit in the liquid sight glasses].

2.17 DISCHARGE-LINE OIL SEPARATOR

Discharge-line oil separator of rated capacity equal to or greater than the compressor capacity shall be provided in the discharge line from each compressor when recommended by the compressor manufacturer for the specific installation. Separator shall be provided with [an oil float-valve assembly] [needle valve and orifice assembly], drain-line shutoff valve, and sight glass. Oil-return line shall be connected to the compressor as recommended by the compressor manufacturer.

2.18 LIQUID-SUCTION INTERCHANGERS

Liquid-suction interchangers shall be provided to increase system efficiency to subcool liquid refrigerant or to prevent liquid refrigerant from entering the compressor.

2.19 LINE STRAINERS

Strainers shall be Y-type with removable basket. Strainers in sizes DN50 2-inch iron pipe size (ips) and smaller shall have solder ends; in sizes DN65 2-1/2-inch ips and larger, strainers shall have flanged ends. Minimum body working-pressure rating shall be 1750 kilopascal 250 psig. Body shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies fitted with bolted-on

screen retainers shall have offset blowdown holes. Body material shall be cast bronze, conforming to ASTM B 62, in sizes DN50 2-inch ips and smaller, and cast bronze or cast iron conforming to ASTM A 278/A 278M, Class 30, in sizes DN65 2-1/2-inch ips and larger.

Minimum free-hole area of strainer element shall be equal to not less than 5 times the internal area of connecting piping. Strainer screens for liquid service shall have perforations not to exceed 0.25 millimeter 0.010 inch (or equivalent wire mesh). Strainer screens for vapor or gas service shall have perforations not to exceed 0.51 millimeter 0.02 inch or equivalent wire mesh. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be [AISI Type [304] [316] corrosion-resistant steel] [Monel metal].

2.20 MUFFLERS

A muffler shall be provided in hot-gas discharge line.

2.21 PIPING SYSTEMS SUPPORTS

Piping systems support materials shall conform to requirements specified under Section 23 05 00.00 40 BASIC MECHANICAL MATERIALS AND METHODS requirements specified herein, and, where not in conflict, the requirements of ASHRAE-04, Chapter 35, ASHRAE-08, ASHRAE 15 and ASME B31.5.

Supports for uninsulated copper tubing shall have wide copper-plated bearing surfaces with lead sheet liners between the tube and the support in the contact area, which shall be secured to the support by turned-under edges.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations and in accordance with Section 23 05 00.00 40 BASIC MECHANICAL MATERIALS AND METHODS.

3.2 TESTING

Testing of system shall be performed in accordance with manufacturer's recommendations and Section 23 05 93.00 40 TESTING, ADJUSTING AND BALANCING.

-- End of Section --