SECTION 23 2300

REFRIGERANT PIPING

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LANL MASTER SPECIFICATION SECTION

Word file at <http://engstandards.lanl.gov>

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| Rev. 4 Summary of changesInserted test pressures and duration for piping pressure tests. Updated Code references. Removed design notes for seismic design requirements. Clarified use of unlisted components from the LANL Reputable Manufacturers List. |

This template was developed to meet the requirements for ASME B31.5-2019. Use with a different edition requires a detailed review of the code and ESM Chapter 17.

The designer is encouraged to review the DOE Handbook 1132, Design Considerations and ESM Chapters 6, 13, and 17.

This template must be edited for each project.  In doing so, specifier must add job-specific requirements.  Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  This section must also be edited to delete requirements for processes, items, or designs that are not included in the project—and specifier’s notes such as these.

Please contact POC with suggestions for improvements.
When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General requirements.

This template was developed for ML-4 projects.  For ML-1, 2, and 3 applications, additional requirements might be necessary if increased confidence in procurement or execution is desired, and independent review is necessary. See ESM Chapter 1 Section Z10 specifications and quality sections.

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1. GENERAL
	1. SECTION INCLUDES
		1. Site and building refrigerant piping, fittings, and refrigeration specialties.
	2. RELATED SECTIONS
		1. Section 01 2500, *Substitution Procedures*
		2. Section 01 3300, *Submittal Procedures*
		3. Section 01 4000, *Quality Requirements*
		4. Section 01 4455, *Onsite Welding and Joining Requirements*
		5. Section 01 4115, *Pressure Safety Submittals*
		6. Section 01 4631, *Welding of ASME B31 Piping*
		7. [Section 01 8113 [LEED v4 and]Guiding Principles 2020: *Requirements for water efficiency, energy efficiency, material composition, and indoor air quality requirements]*
		8. Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment*
		9. Section 22 0554, *Identification for Plumbing, HVAC, and Fire Protection and Equipment*
		10. Section 22 0713, *Plumbing and HVAC Insulation*
		11. Section 22 0813, *Testing Piping Systems*
		12. Section 31 2000, *Earth Moving*
	3. References

Most widely or uniquely used at LANL applications are listed. Not all applicable standards are listed. For ASME codes and standards, the latest published edition in effect at the time this code is specified is the specific edition referenced by the code unless otherwise specified in the engineering design.

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Designer note:

In the listing below, designer must eliminate standards that are not applicable to the project and add standards that are applicable to the project. Then, designer must either (1) specify each B31.5-listed materials’ national standard edition for each remaining standard listed or (2) determine latest is equivalent. Then modify 1.3.B to either (1) keep the first option—and also list the edition year after each standard number (e.g., ASTM F493-04) or (2) keep the second option and eliminate outdated edition years from references other than B31.5 itself.

Specific edition reference dates are not always provided for ASME codes and standards. For ASME codes and standards, the latest published edition in effect at the time this Code is specified is the specific edition referenced by the Code unless otherwise specified in the engineering design.

This template was developed to meet the requirements for ASME B31.5-2019. Application of this template to a different edition of the ASME code will require a detailed review of the code and ESM Chapter 17.

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* + 1. ASME B31.5 – [2019][YEAR], Refrigerant Piping and Heat Transfer Components.
		2. [All national standards invoked herein shall be taken to be the edition in effect for the code of record listed above in 1.3.A and shown below, unless noted otherwise] [All national standards invoked below and herein shall be taken to be the latest edition].
		3. ASME (American Society of Mechanical Engineers)
1. ASME B1 Series
	1. ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form)
	2. ASME B1.20.1, Pipe Threads, General Purpose (Inch)
2. ASME B16 Series

ASME B16.15, Cast Copper Alloy Threaded Fittings Classes 125 and 250

ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

ASME B16.50, Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings

1. ASME Boiler and Pressure Vessel Code (ASME BPVC)

ASME BPVC Section V, Nondestructive Examination

ASME BPVC Section IX, Welding, Brazing, and Fusing Qualifications

* + 1. ASTM International
			1. ASTM B32-2004, Standard Specification for Solder Metal
			2. ASTM B42-2002, Standard Specification for Seamless Copper Pipe, Standard Sizes
			3. ASTM B280-2003, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
			4. ASTM B813-2010, Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
		2. AWS (American Welding Society)
			1. AWS D1.1-2015, Structural Welding Code —Steel, 23rd Edition
			2. AWS A5.8M/A5.8:2004, Specification for Filler Metals for Brazing and Braze Welding
		3. SAE
			1. SAE J461-1981 (2002), Wrought and Cast Copper Alloys
			2. SAE J513-1999, Refrigeration Tube Fittings General Specifications
		4. ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
			1. ASHRAE 15–2019, Safety Standard for Refrigeration Systems
			2. ASHRAE 34–2019, Designation and Safety Classification of Refrigerants
1. ACTION Submittals
2. The following information shall be submitted for all relevant components:
	* 1. Product Data for all components: Include the Manufacturer’s name, model number, parts list,
		2. Spare Parts and Maintenance Materials list
		3. Installation, Operation, & Maintenance Manual
		4. Warranties
3. Per the requirements of 01 4444, *Offsite Welding and Joining Requirements* and/or 01 4455, *Onsite Welding and Joining Requirements*, submit:

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When Offsite only, delete submittals below regarding Onsite welding. For high-risk applications such as FS1 or FS 2 or ML-1 or ML-2, add submittals for “Weld Filler Material Control Procedures” and “Filler Material Certified Material Test Reports CMTRs)” when required. Add “Post-Weld Heat Treatment Procedures” when required.

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* + - * 1. Welding Procedure Specification (WPS) and supporting Procedure Qualification Record (PQR). [Note: For Onsite welding use of LANL WPS/PQR is the default; coordinate usage with the LANL CWI; no submittal required]
				2. Welder Performance Qualification Records (WPQR) including continuity [Note: For Onsite, welders are tested by LANL who will produce WPQR and track continuity; this includes brazing, bonding and fusing; no submittal required]
				3. Inspector qualification records
				4. Inspection procedures
				5. Weld inspection report(s) and weld map(s)
1. Submit Non-Destructive Examination (NDE) procedures as defined by 538.4.3 Leak Test, and personnel qualifications as defined by 536.3 Examination Personnel Qualification and Certification.
	1. Provide “LANL Refrigerant Service Record Form”, ENV-ES-QP-312.10.
	2. Provide all submittals required by Section 01 4115, *Pressure Safety Submittals*, for the as-built configuration under this Section.
2. CLOSEOUT SUBMITTALS
	* 1. Submit under this Section the system and component documentation per 01 4115, Pressure Safety Submittals.
3. QUALITY ASSURANCE
4. Follow Section 01 4000, *Quality Requirements.*
5. Material Control Procedure
	* + 1. Perform Work to an approved Material Control Procedure. This procedure shall describe the control methods and documentation used to handle and monitor the use of controlled materials (piping component, fasteners, and welding filler rod and other components).
			2. The procedure shall follow manufacturer’s requirements for storage and handling.
			3. The procedure shall also address procurement controls, segregation of materials, and traceability of materials from receipt at the shop through processing and final assembly.
		1. Inspection and Testing
			1. Subcontractor shall perform inspection and testing to verify the conformance to the requirements in PART 2 of this Section.
			2. Subcontractor shall provide an Inspection and Test Plan indicating all testing and inspection functions to be performed, including hold points during fabrication and assembly, as well as during the Factory Acceptance Testing (FAT). Hold points are required during the fabrication process to allow inspection, verification, or approval by LANL before the Subcontractor does further work. LANL has the right to waive Hold Points at their discretion.
			3. Inspection and testing functions shall be performed by qualified personnel using qualified procedures and per specified requirements.
			4. Inspection Records: Subcontractor shall appropriately record, submit, and maintain records documenting the inspection and/or test then submit the completed Inspection Record as part of the QA Document Package. The status of all planned and executed inspection and testing activities shall be logged and traceable to ensure that the required inspection and testing have been performed, and any items that have failed inspection or testing are not inadvertently installed or implemented.
		2. Qualifications
			1. Installer Qualifications
				1. Certify that all personnel have passed relevant qualification tests for joining processes involved and that certification is current.

Metallic Pipe: Welders and braziers shall be qualified per ASME BPVC Section IX per Section 01 4455, *Onsite Welding and Joining Requirements*.

Steel Support Welding: Qualify processes and operators to AWS D1.1/D1.1M.

* + - 1. Qualification of Examination Personnel:
				1. Certified Welding Inspectors (CWI) per Section 01 4455, *Onsite Welding and Joining Requirements*.
				2. Personnel performing other examination shall be certified per Subcontractor’s written practice. Personnel performing nondestructive examination shall be qualified and certified for the method to be utilized following a procedure as described in B&PV Code, Section V.
				3. Certifications of examination personnel shall be maintained for Inspector’s review.
			2. Owner’s Inspector will be qualified per ASME B31.5 Section 537.4 by LANL’s ES-FE Group. LANL will act for DOE to designate Owner’s Inspectors or Designee.
		1. Extent and Retention of Records
			1. The following shall be maintained by the fabricator for a minimum of 3 years:
				1. Procedure specification, procedure qualification, and performance qualification records
				2. Results of weld examinations other than visual
				3. Records of the testing of each piping system, which shall include the following information:

date

identification of piping system tested

testing medium

test pressure

signature of examiner and inspector.

Part 2 PRODUCTS

* 1. product options and substitutions
1. Alternate products may be accepted per Section 01 2500, *Substitution Procedures*.
2. Proposal of unlisted components is strongly discouraged and will be evaluated per 01 2500. Substitutions will be allowed only if the Subcontractor can demonstrate that the product can meet the same code requirements of the item specified in the design. Costs associated with evaluation of unlisted components shall be the responsibility of the Subcontractor.

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Design notes

Brazing reduces the tube rating to the fully annealed condition.

Solder joints shall not be used

Compound or lubricant used on bolt threads shall be suitable for the service conditions and shall not react unfavorably with either the service fluid or the piping material. Reference Manufacturer’s recommendations for suitable compounds and lubricants.

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* 1. REFRIGERANT PIPING
		1. Copper tubing: ASTM B280, type ACR, Alloy 12200, temper shall be soft annealed O60 or drawn general purpose H58. Copper thickness shall meet the alternative method LANL VAR- 2015-011 for the design pressure.
1. Manufacturer: Mueller/Streamline
2. Model Number: Nitrogenized ®ACR Tube (Refrigeration Service Tube)
3. Design Temperature Range: 80°F to 122°F (low side to high side temp per ASME B31.5)
4. Pressure rating: 430 psig minimum
5. Size (OD): (1/8 inch through 1 3/8 inch OD ACR Type L, 1/8 inch through 2 5/8 inch OD ACR Type K)
6. Location: Above grade, [below grade; if below grade specify corrosion control in Part 3, Corrosion Control]
	* 1. Copper-iron tubing: ASTM B280, Alloy 19400
			1. Manufacturer: Mueller/Streamline XHP
			2. Temperature Range: 250 F.
			3. Pressure Rating: 1300 PSI
			4. For piping 1-1/2 inch OD and greater, used on the high pressure side of R410A systems.
	1. Copper Braze and fittings
		1. Copper Braze Filler
7. Per LANL BPS 6000-107-F103-NF (nitrogen purged tube).
	* 1. Process: Torch Brazing (neutral)
8. Filler Metal: AWS A5.8M/A5.8, BCuP-5 silver/phosphorus/copper alloy with melting range 1190 to 1480°F
9. Flux: N/A
10. Comply with Section 01 4455, *Onsite Welding and Joining Requirements.*
	* 1. Copper Braze Fittings (up to 1-3/8” OD)
			1. ASME B16.50 Wrought Copper and Copper Allow Braze-Joint Pressure Fittings. Bores and depth of sockets shall conform to ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings and ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
			2. Location: [Above grade/Below grade]
			3. Size: 1/8 inch through 1 3/8 inch OD ACR Type L, 1/8 inch through 2 5/8 inch OD ACR Type K
			4. Manufacturer: [Muller/Streamline, Elkhart, Nibco]
		2. Copper Braze Fittings (Greater than 1-3/8” OD)
			1. ASME B16.50 Wrought Copper and Copper Allow Braze-Joint Pressure Fittings. Bores and depth of sockets shall conform to ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings and ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
			2. Location: [Above grade/below grade]
			3. Manufacturer: Muller/Streamline XHP Copper Fittings
			4. For piping 1-1/2 inch OD and greater, used on the high pressure side of R410A systems.
		3. Copper Flare Fittings
			1. SAE J513, Refrigeration Tube Fittings General Specifications. Description: A 45 degree flare flared body and nut for use with annealed copper tubing. Materials are SAE J461 CA 360 (half-hard), CA 345 or CA 377 (forged) brass with CA377 nuts. Fittings may have a combination of ASME B1.1 UNF (5/16 to 7/8 inch) or UNS 1 1/16 inch and ASME B1.20.1 NPT tapered threads (1/8 through ¾ inch). Fittings are available based on outside tube diameter.
			2. Location: [Above grade/Below grade]
			3. Size: 1/4 inch annealed tube outside diameter [3/16, 1/4, 5/16, 3/8, 1/2, 5/8, 3/4 tube outside diameter inch]
			4. Temperature range: -65 to +250 °F
			5. Pressure: 550 psig
			6. Manufacturer: Parker
		4. Crimped Flame-Free Fittings
			1. Manufacturer: Parker-Sporlan
			2. Model Number: ZoomLock
			3. Pressure Rating: 600 psig
			4. Size: 1/4" through 1-3/8” (see notes below)
			5. Only the following fittings are permitted: Couplings, Slip Couplings, Caps, SAE Flares1, 90 Elbows2, 45 Elbows3

Note 1: Only 1/4" through 3/4" permitted.

Note 2: 1-3/8” not permitted.

Note 3: 1/4" 45 Elbows not available.

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Design notes

Specify required refrigeration specialties such as filter-dryers, solenoid valves, expansion valves, moisture and liquid indicators, strainers, pressure regulators, etc., to suit project. Items must meet the ASME B31.5 requirements for components.

All of the following components are either standard piping components (listed items) per ASME B31.5 para. 526 or have previously LANL approved unlisted component evaluations in accordance with ASME B31.5 para. 504.7.

The types of components shown may be a non-exhaustive list. Any substitutions or additions shall be ASME B31.5 compliant. All previously LANL approved B31.5 components are available in LANL ESM Ch. 17.

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* 1. REFRIGERAtion piping components
1. Solenoid Valve: Brass valve, Pilot operator, MKC-2 coil kit, synthetic to metal main port, stainless steel pin to synthetic seal pilot port, stainless steel stem and plunger assembly, piston disc.
	* + 1. Manufacturer: Sporlan
			2. Model Number: E series HP
			3. Pressure rating: 700 psig
			4. Size: 3/8 inch through 1-1/8”
2. Ball Valve Forged Brass Body, Polished Brass or Carbon Steel Ball
	* + 1. Manufacturer: Superior Refrigeration Products
			2. Model Number: WA, WAS, WBS, MST
			3. Temperature Range: -40 to 325 deg F
			4. Pressure rating: 800 psig
			5. Size: ¼ inch through 4-1/8 inch
3. Moisture and Liquid Indicator, Sight Glass
	* + 1. Manufacturer: Sporlan
			2. Model Number: "See-All"
			3. Temperature Range: -50 to 149°F
			4. Pressure rating: 650 psig
			5. Size: 1/4 inch through 2-1/8 inch
4. Thermostatic Expansion Valve Fill Valve Machined brass bar body, brass port machined into body, stainless steel pin and pushrod, max external leakage – 0.10 oz/yr at 300 PSIG.
	* + 1. Manufacturer: Parker-Sporlan
			2. Model Number: Type [R/ER]
			3. Pressure rating: 450 psig
			4. Size: [Specify inlet/outlet sizes], SAE J513 flare ends.
5. Metal Hose - Vibration Elimination, by size and material; Bronze hose and braids, female copper tube ends 1/8 inch to 1-1/4 inch.
	* + 1. Manufacturer: Anaconda Universal
			2. Model Number: [1212FY] [verify model number with manufacturer]
			3. End Connection: Inside conforms to ASME B16.18 and B16.22.
			4. Pressure rating: 450 psig
			5. Size: 1/8 inch through 1-1/4 inch

# PART 3 EXECUTION

1. PREPARATION
	* 1. Ream pipe and tube ends. Remove burrs.
		2. Remove corrosion, scale, and dirt on inside and outside before assembly.
		3. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
		4. Pre Assembly Cleaning
			1. Subcontractor shall be responsible for the cleanliness and integrity of the system. Internal and external of pipe, tube, and components shall be free of loose scale, sand, dirt, paint, metal chips, filings, flux, slag, weld spatter, mill scale, rust, grease, oil, waxes, or other contaminants that are easily seen with the unaided eye.
			2. Consult manufacturer’s recommendation for the use of acids and cleaning agents to prevent damage.
			3. Ensure safeguards are taken to protect personnel from hazards of cleaning, which may include but not be limited to flying particulates, corrosive chemicals, and harmful vapors.
			4. A suitable chemical and/or mechanical cleaning method shall be used, if necessary, to clean all surfaces to be fabricated.
2. FLEXIBLE CONNECTIONS

A. Install flexible connections for [\_\_\_\_\_\_\_\_\_] where shown on drawings.

1. PRE-ASSEMBLY
	* 1. Verify materials are correct before assembly per the accepted Material Control Procedure.
		2. Fastener materials shall be free of nicks, burrs, chips, dirt, and damage (inspect threads, shank, and nuts). All damaged fasteners must be replaced.
2. ASSEMBLY
	* 1. Soldering shall not be used for refrigeration piping*.*
		2. Brazing: Per Section 01 4631, Welding of ASME B31 Piping.
		3. 45 Degree Flare (SAE J513)
			1. Cut tubing squarely and clean tube end thoroughly to remove burrs.
			2. Place nut onto tube. Place threaded end of nut toward end of tube.
			3. Flare tube end with flaring tool to provide 45° flare.
			4. No scratches, breaks, or other mars at sealing surface of flare shall be permitted.
			5. Clamp tube flare between nut and nose of fitting body by screwing nut on finger-tight. Tighten with a wrench an additional 1/4 turn for a metal-to-metal seal.
		4. Crimped flame-free fittings
			1. Assemble per manufacturer’s instructions.
3. BURIED PIPING
	* 1. Provide earth cover, bedding, and warning tape per Drawings and Section 31 2000, *Earth Moving*.
4. HANGER AND SUPPORT INSTALLATION
	* 1. Support piping per Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment.*
5. INSTALLATION – Above ground piping system
	* 1. Where more than one piping system material is specified, provide compatible system components and joints.
		2. Provide unions or couplings at locations requiring servicing. Use unions or couplings downstream of valves and at equipment connections. Do not use direct-welded or threaded connections to equipment or major valves.
		3. Provide flexible connectors at or near equipment where piping configuration does not absorb vibration.
		4. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
		5. Route piping parallel to building structure and maintain gradient.
		6. Install piping to conserve building space, and not interfere with use of space.
		7. Group piping whenever practical at common elevations.
		8. Provide access where valves and fittings are not exposed.
		9. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 1/2 inch in 10 feet, and in direction of flow.
		10. Install valves with stems upright or horizontal, not inverted.
		11. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
		12. Comply with ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
		13. No pipe or tube bends are allowed. Fittings are to be used instead of bends.
6. INSULATION INSTALLATION
	* 1. Insulate piping per Section 22 0713, *Plumbing and HVAC Insulation.*
		2. Sleeve pipe passing through partitions, walls and floors. Provide UL/FM-approved, through-penetration firestop system when penetrating a fire-rated barrier (e.g., certain walls, floors, etc.).
7. LAbeling
	* 1. Label piping per Section 22 0554, *Identification for Plumbing, HVAC, and Fire Piping and Equipment.*

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Examination, Testing, and Inspection notes

The manufacture shall test the coils and assembled piping at 110 percent design and not more than 130 percent design.

Either the low side must be rated for the high side pressure, or there must be manufacturer installed isolation valves so each side may be tested independently.

Testing of the system requires a regulator and relief device to protect against over pressurization. The regulator and the relief device must be sized so that inadvertent over pressurization will not damage equipment. No piping component will be tested to greater than 130% of its design pressure. The relief device set point cannot exceed the maximum test pressure less 10% to accommodate the relief device actuation. The flowrate of the relief device will be based on the maximum flowrate through the regulator using a new full gas cylinder for testing with a maximum pressure of 2265 psig. This is an action submittal.

Testing procedures for bubble leak testing (or equal) using personnel qualified to perform the testing per a qualification manual is required (SNT-TC-1A, *Recommended Practice for Nondestructive Testing Personnel Qualification and Certification*, may be used as a guide). This is an action submittal.

A preliminary test at 25 psig may use to locate major leaks in the system. The LANL Owners Inspection is not required to witness this low pressure test. The LANL Owners Inspector is required to witness the pressure test and leak test.

Reference ASME B31.5-[2020] paragraphs 536.3, 538.3, 538.4.2, 538.4.3

536.3 Examination Personnel Qualification and Certification

Examiners shall have training and experience commensurate with the needs of the specified examinations. For this purpose, SNT-TC-1A, Recommended Practice for Nondestructive Testing Personnel Qualification and Certification, may be used as a guide. The owner shall determine whether examination by other than personnel performing the work is required.

538.3 Factory Testing of Refrigerant Piping

*(a)* All factory-assembled refrigerant piping of every system shall be tested and proved tight by the manufacturer to at least 110% of the design pressure for which it is rated.

*(b)* A pneumatic pressure test applied to the piping of each factory-assembled refrigerating system shall not exceed 130% of the design pressure of any component.

538.4.2 Pressure Test

*(a)* Piping shall be examined before pressure is applied to ensure that it is tightly connected. All items not subject to the pressure test shall be disconnected or isolated by valves, blanks, plugs, or other suitable means.

*(b)* A preliminary test at a gage pressure of up to 25 psig (170 kPa) may be applied, prior to other testing, as a means of locating major leaks.

*(c)* The temperature of the piping system during testing shall be above the ductile–brittle transition temperature.

CAUTION: Take measures to protect personnel from the potential of rupture of piping components during pneumatic testing of systems.

*(d)* The means used to furnish the test pressure shall have either a pressure limiting device or a pressure reducing device and a pressure relief device and gage on the outlet side. The pressure relief device shall be set above the test pressure, but low enough to prevent permanent deformation of any of the system components.

*(e)* The pneumatic test pressure used shall be at least 110% of the design pressure. The test pressure shall not exceed 130% of the design pressure of any component in the system.

*(f)* For large systems that are not completely visible to the testing operator, the pressure in the system shall be gradually increased to one-half of the test pressure, after which the pressure shall be increased in steps of approximately one-tenth of the test pressure until the required

test pressure has been reached. The test pressure shall be continuously maintained for at least 10 min. It may then be reduced to the leak test pressure per para. 538.4.3(c).

*(g)* Mechanical joints at which blanks or plugs are inserted to blank off or facilitate removal of equipment during the pressure test need not be pressure tested after removal of the blank or plug provided the joint passes a subsequent leak test.

538.4.3 Leak Test. After the pressure test in para. 538.4.2 is completed, a leak test shall be performed.

*(a)* Examination for leaks shall be by the gas and bubble formation testing as detailed in ASME BPVC, Section V, Article 10, or by other methods of equal sensitivity.

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1. EXAMINATION, TESTING, AND INSPECTION
	* 1. Pressure test and leak test piping per Section 22 0813, *Testing Piping Systems*.
			1. Pressure test and leak test the refrigerant piping at the following pressures:

|  |  |  |  |
| --- | --- | --- | --- |
| Refrigerant | Minimum Design Pressure | Pressure Test | Leak Test |
| R-410A | High Side 430Low Side 235 | High Side 475 PSIGLow Side 260 PSIG | High Side 450 PSIGLow Side 250 PSIG |
| R-407C | High Side 307Low Side 166 | High Side 340 PSIGLow Side 185 PSIG | High Side 325 PSIGLow Side 175PSIG |
| R-134A | High Side 177Low Side 87 | High Side 200 PSIGLow Side 100 PSIG | High Side 180 PSIGLow Side 90 PSIG |
| R-404A | High Side 320Low Side 235 | High Side 355 PSIGLow Side 260 PSIG | High Side 330 PSIGLow Side 240 PSIG |

NOTE: It is acceptable to test the low side of the refrigeration system at the high side test pressure, if all low side components are rated for the high side design pressure.

If testing of the low side and the high side are done at different pressures, provide positive isolation of the two sides, using factory installed isolation valves and/or service valves that are provided as part of the equipment.

* + - 1. Pressure test with dry nitrogen gas for [10] minutes. Test the high and low side of each system at not less than the pressure noted above for test pressure. Record test with a calibrated pressure. Do not exceed 130% of the design pressure listed above.
				1. Do not use oxygen, acetylene, or other flammable/combustible gases or gas mixtures for leak testing.
			2. After the pressure test is complete, perform a system leak test at the pressures listed in the table above, per ASME B31.5, para. 538.4.3 Leak Test, with personnel qualifications as defined by 536.3 Examination Personnel Qualification and Certification
		1. After successful completion of pressure tests, remove pressurization gas and evacuate system to [500 microns], [*state value* microns] to remove moisture and non-condensables. After this level is reached, remove the vacuum pump and verify that there is no appreciable rise (rise above 1000 microns) after 30 minutes.
		2. Fully charge completed system with refrigerant after testing. If startup is not within 24 hours, temporarily pressurize to 5 psig with system refrigerant.

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Designer note

The following items should be considered during the design.

1. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
2. Install refrigerant service valves in suction and discharge lines of compressor.
3. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
4. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.
5. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top and provide electrical connection to solenoid valves.
6. Install thermostatic expansion valves as close as possible to distributors on evaporators and locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
7. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.
8. Install filter dryers in liquid line between compressor and thermostatic expansion valve or in the suction line of the compressor. Additional filter dryer is not needed if one is provided with the condensing unit.
9. In process examination per paragraph 536.6.2 may be substituted for all or part of the substituted for all or part of radiographic examination on a weld-for-weld basis if specified in the engineering design and specifically approved by the Inspector.

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END OF SECTION

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Do not delete the following reference information:

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THE FOLLOWNG STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 23 2300 Rev. 4, dated May 20, 2022.