

JSC Safety and Health Handbook	JPR No.	1700.1K
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Chapter 6.11 Pressurized Gas and Liquid Systems

This could be you . . .

A technician was burned by a fire in a component of a high-pressure oxygen system. An expansion bellows on a section of piping ruptured during pressure testing and injured several employees. The bellows wasn't properly restrained during the testing.

A gate valve on a high-pressure nitrogen trailer flew off and killed an employee during maintenance. The maintenance workers didn't take all possible steps to make sure that the trailer wasn't pressurized before working on it.

6.11.1 Applicability of this chapter

You are required to follow this chapter if you use pressurized gas or liquid systems.

6.11.2 Requirements for using any pressurized systems

6.11.2.1 All your pressure vessels, pressure systems, and pressure systems components shall:

- a. Be designed, installed, tested, certified, and periodically recertified to the requirements of JPR 1710.13, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems" (current version).
- b. Have their current design, installation, testing, certifications, modifications, periodic recertifications, and maintenance properly documented.
- c. Be marked, tagged, or otherwise identified to indicate the certified use.
- d. Be located to minimize the risk to personnel and surrounding equipment and facilities if a leak or rupture occurs.

6.11.3 Requirements for systems that contain pressure vessels, fixed piping or tubing, valves, or other components

6.11.3.1 Your pressure systems shall:

- a. Meet JPR 1710.13 (current version) for the design, installation, testing, certification, and periodic recertification of your pressure vessel.
- b. Meet American Institute of Aeronautics and Astronautics (AIAA) Guide 095-2004, "Guide to Safety of Hydrogen and Hydrogen Systems," specifications if your pressure system contains hydrogen.
- c. Make sure that relief valves and other discharge parts follow minimum separation distances as called out in the references given above.
- d. Properly restrain relief valves, rupture discs, burst discs, and associated piping or tubing to prevent movement from the thrust created by a pressure release.
- e. Properly bond and ground your systems.

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6.11.4 Requirements for fire protection systems

All fire protection systems shall meet the requirements of the National Fire Protection Association (NFPA) for the specific type of fire protection system involved.

6.11.5 Requirements for flex hoses

6.11.5.1 You shall meet the following requirements:

- a. Proof pressure-test and tag flex hoses according to the requirements of JPR 1710.13 (current version).
- b. Secure flex hoses that are not in a cabinet or other containment and that are used in 150-psig or greater normal service at both ends and tether or weigh them down at no greater than 6-foot intervals, and you shall:
 - (1) Secure hoses between 3 and 6 feet in length at both ends and tether or weigh them down in the middle. Hoses shorter than 3 feet in length only need to be secured at both ends.
 - (2) Ensure that this securing, tethering, or weighting is sufficient to withstand forces arising from sudden failure. Strapping hoses together is considered tethering.
 - (3) Secure flex hose vent and drain lines at the free end.
- c. Flex hoses need not be secured if in vacuum service or if a written hazard analysis or technical order, which controls the hazard, is approved by the Safety and Test Operations Division.
- d. For COTS flex hoses, with the exception of hoses having quick disconnect type fittings, the hose end fittings connected to rigid pieces are considered to provide adequately secured restraint at the hose ends without having to redundantly secure them by any additional method such as tethering or strapping. A rigid attach point is defined as fixed hardware capable of withstanding MAWP. Hoses longer than 3 feet with ends secured in this manner must still be secured in the middle and at intervals not to exceed 6 feet.

6.11.6 Requirements for systems using oxygen or oxygen-enriched gas (greater than 25 mole percent oxygen or oxygen greater than 25% oxygen by volume)

6.11.6.1 You shall meet the following requirements:

- a. Oxygen systems shall meet NASA-STD-6001, "Flammability, Odor, Off-Gassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion." Use ASTM MNL36, "Manual for Safe Use of Oxygen Systems: Handbook for Design, Operations, and Maintenance," as a guide.
- b. For systems using oxygen or oxygen-enriched gas above 250 psi and that involve humans in the loop, you need to flow the oxygen through the system unmanned before introducing a human into the system. Examples of these systems include chambers and breathing gas systems. Testing shall follow these requirements:
 - (1) Test new systems and test, after modifications, existing systems that require disassembly and reassembly of the parts of the system.
 - (2) Test the system at maximum operating pressure (just below relief valve pressure) for 10

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cycles.

- (3) Sample for chemical purity per MIL-PRF-27210. Also test moisture levels per specific program requirements. Sample the system before use, or monthly and after any maintenance activities that violate system integrity.

6.11.7 Requirements for using non-bulk compressed gas cylinders

6.11.7.1 You shall meet all the requirements of 29 CFR 1910.101, "Compressed Gas Cylinders."

The Logistics Division is the only authorized avenue for purchasing and disposing of non-bulk compressed gas cylinders for use at JSC, Ellington Field, and SCTF, including gases used by onsite contractors. For safety and accountability, NASA- and vendor-owned cylinders are tracked, disposed of, and/or returned to vendors when no longer required. Any unauthorized gas purchases will be held in the hazardous storage area and may be returned to the vendor. As an authorized user of compressed gas cylinders, you shall:

- a. Send gas requests to the Logistics Support Contractor/Bldg. 421 on a JSC Form 1710, JSC Warehouse Requisition, or fax to x46540.
- b. Contact the Logistics Support Contractor at x36547 for pickup of cylinders that are empty or no longer needed.
- c. For cylinder(s) that contain hazardous material(s), list the contents on JSC Form 1161 and attach the completed form to the cylinder(s) before pickup to ensure correct disposition. If the cylinder is empty, no form 1161 is required. A compressed gas container is empty if it is at atmospheric pressure.

6.11.8 For more information on pressurized gases and liquids

- a. 29 CFR 1910.101
- b. JPR 1710.13 (current version)
- c. NASA-STD-6001, "Flammability, Odor, Off-Gassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion"
- d. ASTM MNL36, "Manual for Safe Use of Oxygen Systems: Handbook for Design, Operations, and Maintenance"
- e. AIAA Guide 095-2004, "Guide to Safety of Hydrogen and Hydrogen Systems"