



**ENVIRONMENTAL HEALTH AND SAFETY  
LABORATORY SAFETY DESIGN GUIDE--  
PRESSURE VESSEL COMPONENTS AND  
SYSTEMS**

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## V. PRESSURE VESSEL COMPONENTS AND SYSTEMS, AND COMPRESSED-GAS CYLINDERS

### A. Scope

This Design Guide applies to all facilities, including leased properties. It covers all unfired pressure vessels (i.e., storage tanks, compressed-gas cylinders) that have been designed to operate at pressures above 15 psi, including the storage and use of compressed-gas cylinders and cryogenic fluids. This does not cover utilities (i.e., “house air”) inspected and maintained by Facilities Services.

### B. Compressed-gas Cylinder Storage

1. Cylinders of compressed gases shall be stored in areas where they are protected from external heat sources such as flame impingement, intense radiant heat, electric arcing, or high temperature steam lines.

*SFC/WSFC (IFC) Chapter 30, Section 3003*

2. The heating of flammable-gas storage areas shall be indirectly heated, such as by air, steam, hot water, etc.

*Good Practice*

*SFC/WSFC (IFC) Chapter 30, Section 3003.5.6 & 3003.5.7*

3. Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards.

*SFC/WSFC (IFC) Chapter 30, Section 3007.2 and associated chemical specific chapters of the IFC*

4. Adequate space shall be made available for the segregation of gases by hazard class. Flammable gases shall not be stored with oxidizing agents. Separate storage for full and empty cylinders is preferred. Such enclosures shall serve no other purpose. Inside buildings, cylinders shall be stored in well-protected, well-ventilated, dry locations, and flammable gas cylinders shall be at least twenty feet from materials classified as oxidizers and 10 ft. from combustible materials. Valves, pipe fittings, regulators and other equipment shall be constructed of materials and have pressure ratings compatible with the gas being used.

*SFC/WSFC (IFC) Chapter 30 & Chapter 35*

*SFC/WSFC (IFC) Chapter 27, Section 2703.9.8*

*Good Practice*

5. Liquefied fuel-gas cylinders shall be stored/transported in an upright position so that the safety relief device is in direct contact with the vapor

space in the cylinder at all times.

*SFC/WSFC (IFC) Chapter 38, Section 3809.3*

*NFPA 58*

6. Storage rooms shall be provided with explosion control when toxic or highly toxic flammable gases are stored outside gas cabinets or exhausted enclosures.

*Required for SBC/WSBC (IBC) H-5 occupancies.*

7. When separate gas storage rooms are provided, they shall operate at a negative pressure in relation to the surrounding area and they shall also direct the exhaust ventilation to the fume exhaust system assuring that incompatible gases are not mixed in the ductwork.

*Required for SBC/WSBC (IBC) H-5 occupancies.*

*Where separate rooms are used to store nonflammable gases and/or storage is below "H" occupancies limits room exhaust ventilation can be to the general building exhaust system.*

8. Storage areas shall be secured against unauthorized entry.

*SFC/WSFC (IFC) Chapter 30, Section 3003.3.1*

9. The storage of compressed-gas cylinders shall not obstruct exits or routes of egress. Also, compressed-gas cylinders shall not be stored near in locations where moving objects may strike or fall upon them.

*Good Practice*

*The design intent should be to locate gas cylinders in designated rooms for bulk storage and in locations within laboratories that would not impede exiting pathways.*

10. Emergency power shall be provided for "H" occupancy gas storage rooms, gas-cabinet exhaust ventilation, gas-detection systems, emergency alarm systems, and temperature control systems.

*Required for H-5 occupancies, but good practice for other situations.*

## **C. Compressed-gas Cylinder Restraint**

1. Approved storage racks (e.g., Unistrut, pipe racks) shall be provided that adequately secure gas cylinders by chains, metal straps, or other approved materials, to prevent cylinders from falling or being knocked over. Chains are preferable to straps. Straps shall be non-combustible.

*SFC/WSFC (IFC) Chapter 30, Section 3003.3.1*

*NFPA 45, 8-1.5*

2. Cylinder restraints shall be sufficient to prevent cylinders from tipping

over. In seismically active areas, more than one chain/strap should be used (double chains/straps should be located at one-third and two-thirds the height of the cylinder).

*Prudent Practices in the Laboratory 4.E.4*

*Good Practice*

3. Chain/strap restraints shall be used to restrain a maximum of three cylinders per chain/strap or per set of chains/straps (if double-chained/strapped).

*Good Practice*

4. Gas-cylinder securing systems should be anchored to a permanent building member or fixture. This connection is needed to prevent movement during a seismic event.

*Good Practice*

## D. Requirements for Gas Cabinets

1. Storage and use of toxic and highly toxic compressed-gas cylinders shall be within exhaust-ventilated gas storage cabinets, laboratory fume hoods, exhausted enclosures, or separate ventilated gas storage rooms without other occupancy or use. It is acceptable to mount lecture bottles connected to a manifold in a fume hood.

Required for SBC/WSBC (IBC) H-5 occupancies, but good practice for situations using toxic and highly toxic compressed gases.

2. Gas cabinets shall be located in a room which has non-recirculated exhaust ventilation; this room operates at a negative pressure in relation to the surrounding area, and is connected to the fume exhaust system.

*Good Practice*

3. Gas cabinets shall have self-closing doors and may require internal sprinklers; they shall also be constructed of at least 0.097-inch (12-gauge) steel; and seismically anchored.

4. Gas cabinets shall be fitted with sensors connected to alarms that give warning in the event of a leak, or exhaust system failure, as appropriate.

Required for H-5 occupancies, but good practice for other situations. For planning purposes, gas cabinets shall contain not more than three cylinders each, except where cylinder contents are one pound net or less, in which case gas cabinets may contain up to 100 cylinders each. Gas cabinets shall comply with semiconductor industry standards.

## E. Design of Pressure Vessels and Systems

1. Normal and emergency relief venting and vent piping for pressure vessels should be adequate and in accordance with the design of the vessel.

*ASME Boiler and Pressure Vessel Code for Unfired Pressure Vessels*