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210. COMPRESSED GAS. (7-1-97)

01. Scope: (7-1-97)

a. Compressed gas use and storage, to include chlorine, shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. (7-1-97)

02. Definitions: For definitions of other terms used in this section, see sub-section 010 of this standard. (7-1-97)

a. Approach Channel is the passage or passages through which gas must pass from the cylinder to reach the operating parts of the safety relief device. (7-1-97)

b. Bulk oxygen system is an assembly of equipment, such as oxygen storage containers, pressure regulators, safety devices, vaporizers, manifolds, and interconnecting piping which has storage capacity of more than thirteen-thousand (13,000) cubic feet of oxygen; Normal Temperature and Pressure (N.T.P.), connected in service or ready for service, or more than twenty-five-thousand (25,000) cubic feet of oxygen (N.T.P.) including unconnected reserves on hand at the site. The
bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers may be stationary or movable, and the oxygen may be stored as gas or liquid. (7-1-97)

c. Cargo Tank is any container designed to be permanently attached to any motor vehicle or other highway vehicle and in which any compressed gas is to be transported. The term cargo tank shall not be construed to include any tank used solely for the purpose of supplying fuel for the propulsion of the vehicle or containers fabricated under specifications for cylinders. (7-1-97)

d. Code is the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers or the Code for Unfired Pressure Vessels for Petroleum Liquids and Gases of the American Petroleum Institute and the American Society of Mechanical Engineers (API-ASME). (7-1-97)

e. Combination Frangible Disc-fusible Plug is a frangible disc in combination with a low melting point fusible metal, intended to prevent its bursting at its predetermined bursting pressure unless the temperature also is high enough to cause yielding or melting of the fusible metal. (7-1-97)

f. Combination Safety Relief Valve and Fusible Plug is a safety relief device utilizing a safety relief valve in combination with a fusible plug. This combination device may be an integral unit or separate units and is intended to open and close at predetermined pressures or to open at a predetermined temperature. (7-1-97)

g. Corrosion, General is a corrosion which covers considerable surface areas of the cylinder. (NOTE: It reduces the structural strength. It is often difficult to measure or estimate the depth of general corrosion because direct comparison with the original wall cannot always be made. General corrosion is often accompanied by pitting.) (7-1-97)

h. Corrosion, Line is pitting which is not isolated but are connected or nearly connected to others in a narrow band or line. (NOTE: This condition is more serious than isolated pitting. Line corrosion frequently occurs in the area of intersection of the foot-ring and bottom of a cylinder. This is sometimes referred to as "crevice corrosion.") (7-1-97)

i. Corrosion, Pitting is corrosion or pitting in cylinders involving the loss of wall thickness by corrosive media. (NOTE: There are several kinds of pitting or corrosion to be considered.) (7-1-97)

j. Cuts, Gouges, or Digs. Cuts, gouges, or digs (in cylinders) are deformities caused by contact with a sharp object in such a way as to cut into or upset the metal of the cylinder, decreasing the wall thickness at that point. (7-1-97)

k. Dents (in cylinders) are deformities caused by the cylinder coming in contact with a blunt object in such a way that the thickness of metal is not materially impaired. (7-1-97)
l. Discharge Channel is the passage or passages beyond the operating parts through which gas must pass to reach the atmosphere exclusive of any piping attached to the outlet of the device. (7-1-97)

m. DOT Design Pressure is identical to the term maximum allowable working pressure as used in the Code and is the maximum gage pressure at the top of the tank in its operating position. To determine the minimum permissible thickness of physical characteristics of the different parts of the vessel, the static head of the lading shall be added to the DOT design pressure to determine the thickness of any specific part of the vessel. If vacuum insulation is used, the liquid container shall be designed for a pressure of fifteen (15) p.s.i. more than DOT design pressure, plus static head of the lading. EXCEPTION: For containers constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code, the maximum allowable working pressure for the purpose of these standards is considered to be twelve (12) percent of the design pressure as provided in 49 CFR 173.315 of DOT Regulations. (7-1-97)

n. DOT Regulations as used in this section, refer to the U.S. Department of Transportation Regulations for Transportation of Explosives and Other Freight, Express and Baggage Services and by Motor Vehicle (Highway) and Water, including Specifications for Shipping Containers, Code of Federal Regulations, Title 49, Parts 171 to 178. (7-1-97)

o. Flow Capacity of a safety relief device is the capacity in cubic feet per minute of feet air discharged at the required flow rating pressure. (7-1-97)

p. Flow Rating Pressure is the pressure at which a safety relief device is rated for capacity. (7-1-97)

q. Frangible Disc is an operating part in the form of a disc usually of metal and which is so held as to close the safety relief device channel under normal conditions. The disc is intended to burst at a predetermined pressure to permit the escape of gas. (7-1-97)

r. Free Air or Free Gas is air or gas measured at a pressure of fourteen-point-seven (14.7) pounds per square inch absolute and a temperature of sixty (60) degrees Fahrenheit. (7-1-97)

s. Fusible Plug is an operating part in the form of a plug of suitable low melting material, usually a metal alloy, which closes the safety relief device channel under normal conditions and is intended to yield or melt at a predetermined temperature to permit the escape of gas. (7-1-97)

t. High-pressure cylinders are those cylinders with a marked service pressure of nine-hundred (900) p.s.i. or greater. (7-1-97)

u. Isolated Pitting is isolated pits of small cross-section which do not effectively weaken the cylinder wall but are indicative of possible complete penetration and leakage. (NOTE: Since the pitting is isolated, the original wall is essentially intact.) (7-1-97)

v. Liquefied Compressed Gas is a gas which, under the charging pressure, is partially liquid at a temperature of seventy (70) degrees Fahrenheit. A flammable compressed gas which is normally
non-liquefied at seventy (70) degrees Fahrenheit but which is partially liquid under the charging pressure and temperature, shall follow the requirements for liquefied compressed gases. (7-1-97)

w. Low-pressure cylinders are those with a marked service pressure less than nine-hundred (900) p.s.i. (7-1-97)

x. Minimum Allowable Wall Thickness is the minimum wall thickness required by the specification under which the cylinder was manufactured. (7-1-97)

y. Non-liquefied Compressed Gas is a gas, other than a gas in solution which under the charging pressure, is entirely gaseous at a temperature of seventy (70) degrees Fahrenheit. (7-1-97)

z. Operating Part of a safety relief device is the part of the safety relief device that normally closes the safety discharge channel but when moved from this position as a result of the action of heat or pressure, or a combination of the two, permits escape of gas from the cylinder. (7-1-97)

aa. Portable Tank is any container designed primarily to be temporarily attached to a motor vehicle, other vehicle, a railroad car other than a tank car, or marine vessel, and equipped with skids, mounting, or accessories to facilitate handling of the container by mechanical means, in which is to be transported any compressed gas. The term portable tank shall not be construed to include any cargo tank, any tank car tank or any tank of the DOT-106A and DOT-110A-W type. (7-1-97)

bb. Pressure Opening is the orifice against which the frangible disc functions. (7-1-97)

c. Pressurized Liquid Compressed Gas is a compressed gas other than a compressed gas in solution, which cannot be liquefied at a temperature of seventy (70) degrees Fahrenheit, and which is maintained in the liquid state at a pressure not less than forty (40) p.s.i.a. by maintaining the gas at a temperature less than seventy (70) degrees Fahrenheit. (7-1-97)

d. Rated Bursting Pressure of a frangible disc is the maximum pressure for which the disc is designed to burst when in contact with the pressure opening for which it was designed when tested. (7-1-97)

e. Reinforced Fusible Plug is a fusible plug consisting of a core of suitable material having a comparatively high yield temperature surrounded by a low melting point fusible metal of the required yield temperature. (7-1-97)

ff. Resealing Pressure of a safety relief valve is the pressure at which leakage ceases through a water seal of not more than four (4) inches on the outlet of the valve. (7-1-97)

gg. Safety Relief Device is a device intended to prevent rupture of a cylinder under certain conditions of exposures. (The term as used herein shall include the approach channel, the operating parts, and the discharge channel.) (7-1-97)
hh. Safety Relief Device Channel is the channel through which gas released by operation of the device must pass from the cylinder to the atmosphere exclusive of any piping attached to the inlet or outlet of the device. (7-1-97)

ii. Safety Relief Valve is a safety relief device containing an operating part that is held normally in a position closing the safety relief device channel by spring force and is intended to open and to close at predetermined pressures. (7-1-97)

jj. Set Pressure of a safety relief valve is the pressure marked on the valve and at which it is set to start-to-discharge. (7-1-97)

kk. Start-to-discharge Pressure of a safety relief valve is the pressure at which the first bubble appears through a water seal of not more than four (4) inches in the outlet of the safety relief valve. (7-1-97)

ll. Test Pressure of the Cylinder is the minimum pressure at which a cylinder must be tested as prescribed in DOT specifications for compressed gas cylinders (41 CFR Ch. 1). (7-1-97)

mm. Yield Temperature of a fusible plug is the temperature at which the fusible metal or alloy will yield when tested. (7-1-97)

03. General Requirements. (7-1-97)

a. Each employer shall determine that compressed gas cylinders and pressure piping under his control are approved for the intended use and are in a safe condition to the extent that this can be determined by visual inspection. Damaged gas cylinders shall not be used. (10-1-06)

b. The requirements contained in this section is not intended to apply to cylinders manufactured under specification DOT (ICC)-3HT (49CFR Ch. 1). Separate requirements covering service life and standards for visual inspection of these cylinders are contained in Compressed Gas Association Pamphlet C-8, "Standard for Re-qualification of ICC-3HT Cylinders." (7-1-97)

c. Experience in the inspection of cylinders is an important factor in determining the acceptability of a given cylinder for continued service. NOTE: Users lacking this experience and having doubtful cylinders should return them to a manufacturer of the same type of cylinders for reinspection or replacement. (7-1-97)

d. The in plant handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tank cars, or motor vehicle cargo tanks shall be in accordance with Compressed Gas Association Pamphlet P-1-1965. (7-1-97)

e. A suitable cylinder truck, cart, chain, or other securing device shall be used to prevent all compressed gas cylinders from being knocked over while in use or in storage, empty or full. (7-1-97)
f. Compressed gas cylinders shall be legibly marked, for the purpose of identifying the gas content, with either the chemical or trade name of the gas. Such marking shall be by means of stenciling, stamping, or labeling, and shall not be readily removable. Whenever practicable, the marking shall be located on the shoulder of the cylinder. (7-1-97)

g. Compressed gas cylinders shall be equipped with connections complying with ANSI B57.1. (7-1-97)

h. All cylinders with a water weight of over thirty (30) pounds shall be equipped with a means of connecting a valve protection cap or with a collar or recess to protect the valve. (7-1-97)

i. When transporting cylinders by a crane or derrick, boat, or other like transport a suitable cradle or platform shall be used. Slings or electric magnets shall not be used for this purpose. Valve protection caps, where the cylinder is designed to accept a cap, shall always be in place. (7-1-97)

j. Cylinders shall not be dropped, struck, or permitted to strike each other violently. (7-1-97)

k. Valve protection caps shall not used for lifting cylinders from one vertical position to another. Bars shall not be used under valves or valve protection caps to pry cylinders loose when frozen to the ground or otherwise fixed; the use of warm water (not boiling) is recommended. (7-1-97)

l. Unless cylinders are secured on a special truck or cart, regulators shall be removed and valve protection caps, when provided for, shall be put in place before the cylinders are moved. (7-1-97)

m. Cylinders not having fixed hand wheels shall have keys, handles, or nonadjustable wrenches on valve stems while these cylinders are in use. In multiple cylinder installations only one key, handle, or nonadjustable wrench is required for each manifold provided the valve stems are identical. (7-1-97)

n. Cylinder valves shall be closed before moving cylinders. (7-1-97)

o. Cylinder valves shall be closed when work is finished or when the cylinder is empty. (7-1-00)

p. Cylinders shall not be placed where they might become part of an electric current. (7-1-97)

q. Cylinders shall not be used as rollers or supports whether full or empty. (7-1-97)

r. The numbers and markings stamped into cylinders shall not be tampered with. (7-1-97)

s. No person, other than the gas supplier, shall attempt to mix gases in a cylinder. No one, except the owner of the cylinder or authorized representative, shall refill a cylinder. (7-1-97)

t. No one shall tamper with safety devices in cylinders or valves. (7-1-97)

u. Cylinders shall not be dropped or otherwise roughly handled. (7-1-97)
v. A hammer or wrench shall not be used to forcibly open cylinder valves. If valves cannot be opened by hand, the supplier shall be notified. (7-1-97)

w. Cylinder valves shall not be tampered with nor shall any attempt be made to repair them. If troubles are experienced, the supplier shall be notified indicating the nature of the trouble and the cylinder's serial number. The supplier's instructions as to its disposition shall be followed. (7-1-97)

x. Complete removal of the stem from a diaphragm type cylinder valve shall be avoided. (7-1-97)

y. Fuel gas cylinders shall be placed with the valve end up whenever they are in use. Liquefied gases shall be stored and shipped with the valve end up. (7-1-97)

z. Cylinders shall be handled carefully. Cylinders shall not be subjected to rough handling, knocks, or falls which are liable to damage the cylinder, valve, or safety devices and cause leakage. (7-1-97)

aa. If cylinders are found to have leaky valves or fittings which cannot be stopped by closing the valve, the cylinders shall be taken outdoors away from sources of ignition and slowly emptied. This procedure does not apply when highly toxic gases are involved. (7-1-97)

bb. A warning shall be placed near cylinders having leaking fuse plugs or other leaking safety devices not to approach them. The warning shall state any appropriate safety precautions to be taken. Such cylinders shall be plainly tagged, the supplier shall be promptly notified and instructions followed as to their return. (7-1-97)

c. Safety devices shall not be tampered with. (7-1-97)

d. The cylinder valve shall always be opened slowly. (7-1-97)

e. Where a special wrench or key is required to open a cylinder valve, it shall be left in position on the stem of the valve while the cylinder is in use so that the gas flow can be quickly turned off in case of an emergency. In the case of manifold or coupled cylinders one such wrench or key shall always be available for immediate use. (7-1-97)

**04. Low-Pressure Cylinders Exempt from Hydrostatic Testing: (including acetylene cylinders.)** (7-1-97)

a. This subsection covers cylinders of the type that are exempt from the hydrostatic retest requirements of the DOT by virtue of their exclusive use in certain noncorrosive gas service. They are not subject to internal corrosion and do not require internal shell inspection. (7-1-97)

b. Gas cylinders shall be prepared for inspection as follows: Rust, scale, caked paint, etc., shall be removed from the exterior surface so that the surface can be adequately observed. Facilities shall be provided for inverting the cylinder to facilitate inspection of the bottom. This is
important because experience has shown this area to be the most susceptible to corrosion. (7-1-97)

c. Cylinders shall be checked externally for corrosion, general distortion, or any other defect that might indicate a weakness which would render it unfit for service. (7-1-97)

d. To fix corrosion limits for all types, designs, and sizes of cylinders and include them in this section is not practicable. Failure to meet any of the following requirements is of itself cause for rejection of a cylinder. A cylinder shall be rejected when the tare weight is less than eighty-five (95) percent of the original tare weight marked on the cylinder. When determining tare weight, be sure that the cylinder is empty. A cylinder shall be rejected when the remaining wall in an area having isolated pitting only is less than one-third (1/3) of the minimum allowable wall thickness as determined under this subsection. A cylinder shall be rejected when line corrosion on the cylinder is three (3) inches in length or over and the remaining wall is less than three-fourths (3/4) of the minimum allowable wall thickness or when line corrosion is less than three (3) inches in length and the remaining is less than one-half (1/2) the minimum allowable wall thickness as determined under this subsection. A cylinder shall be rejected when the remaining wall in an area of general corrosion is less than one-half (1/2) of the minimum allowable wall thickness as determined under this sub-section. (7-1-97)

e. To use the criteria in sub-section 210.04 of this section, it is necessary to know the original wall thickness of the cylinder or the minimum allowable wall thickness. Table 210.04-A lists the minimum allowable wall thickness under DOT Specifications (49 CFR Ch. 1) for a number of common size low-pressure cylinders. (7-1-97)

### TABLE 210.04-A

<table>
<thead>
<tr>
<th>Cylinder size O.D. x length (inches)</th>
<th>DOT Specification marking</th>
<th>Nominal water capacity (pounds)</th>
<th>Minimum allowable wall thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 X 46</td>
<td>14B240</td>
<td>239</td>
<td>0.128</td>
</tr>
<tr>
<td>14 13/16 X 47</td>
<td>4E240</td>
<td>239</td>
<td>.140</td>
</tr>
<tr>
<td>14 15/16 X 46</td>
<td>4BA240</td>
<td>239</td>
<td>.086</td>
</tr>
<tr>
<td>14 11/16 X 28 3/8</td>
<td>4BA240</td>
<td>143</td>
<td>.086</td>
</tr>
<tr>
<td>11 29/32 X 32 11/16</td>
<td>4BA240</td>
<td>95</td>
<td>.078</td>
</tr>
<tr>
<td>11 29/32 X 18 11/32</td>
<td>4BA240</td>
<td>48</td>
<td>.078</td>
</tr>
</tbody>
</table>

1Without longitudinal seams.

f. When the wall thickness of the cylinder at manufacture is not known, and the actual wall thickness cannot be measured, this cylinder shall be rejected when the inspection reveals that the
deepest pit in a general corrosion area exceeds three-sixty-forths (3/64) inch. This is arrived at by considering that in no case shall the pitting exceed one-half (1/2) the minimum allowable wall thickness which is zero point zero-zero-sixty-four (0.064) inch. When a pit measures zero point zero-forty-three (0.043) inch (approximately three-sixty-fourths (3/64) inch) in a corrosion area, general corrosion will already have removed zero point zero-twenty-one (0.021) inch of the original wall and the total pit depth as compared to the initial wall will be zero point zero-sixty-four (0.064) inch. (7-1-97)

g. When the original wall thickness is measured, this thickness less one and one-half (1 1/2) times the maximum measured pit depth shall be zero point zero-sixty-four (0.064) inch or greater. If it is less, the cylinder shall be rejected. (7-1-97)

h. Dents are of concern where the metal deformity is sharp and confined, or where they are near a weld. Where metal deformity is not sharp, dents of larger magnitude can be tolerated. (7-1-97)

i. Where denting occurs so that any part of the deformity includes a weld, the maximum allowable dent depth shall be one-fourth (1/4) inch. (7-1-97)

j. When denting occurs so that no part of the deformation includes a weld, the cylinder shall be rejected if the depth of the dent is greater than one-tenth (1/10) of the mean diameter of the dent. (7-1-97)

k. Cuts, gouges, or digs reduce the wall thickness of the cylinder and in addition are considered to be stress points. Depth limits are set in this section, however, cylinders shall be rejected at one-half (1/2) of the limit set whenever the length of the defect is three (3) inches or more. (7-1-97)

l. When the original wall thickness at manufacture is not known and the actual wall thickness cannot be measured, a cylinder shall be rejected if the cut, gouge, or dig exceeds one-half (1/2) of the minimum allowable wall thickness as determined under this subsection. (7-1-97)

m. When the original wall thickness at manufacture is known, or the actual wall thickness is measured, a cylinder shall be rejected if the original wall thickness minus the depth of the defect is less than one-half (1/2) of the minimum allowable wall thickness as determined under this subsection. (7-1-97)

n. To check for leaks, the cylinder shall be charged and carefully examined. All seams and pressure openings shall be coated with a soap or other suitable solution to detect the escape of gas. Any leakage shall be cause for rejection. (Leaks can originate from a number of sources, such as defects in a welded or brazed seam, defects at the threaded opening, or from sharp dents, digs, gouges, or pits.) (7-1-97)

o. Safety relief devices shall be tested for leaks before a charged cylinder is shipped from the cylinder filling plant. (7-1-97)
Cylinders involved in a fire, shall be carefully inspected for evidence of exposure to fire. Common evidences of exposure to fire are charring or burning of the paint or other protective coat, burning or splintering of the metal, distortion of the cylinder, melted out fuse plugs, burning or melting of a valve. The evaluation of fire damage by DOT Regulations state that, "A cylinder which has been subjected to the action of fire must not again be placed in service until it has been properly reconditioned," in accordance with 49 CFR 173.34(f). The general intent of this requirement is to remove from service cylinders which have been subject to the action of fire which has changed the metallurgical structure or the strength properties of the steel, or in the case of acetylene cylinders caused the breakdown of porous filler. This is normally determined by visual examination as covered above with particular emphasis to the condition of the protective coating. If the protective coating has been burnt off or if the cylinder body is burnt, warped, or distorted, it is assumed that the cylinder has been overheated and 49 CFR 173.34(f) shall be complied with. If, however, the protective coating is only dirtied from smoke or other debris, and is found by examination to be intact underneath, the cylinder shall not be considered affected within the scope of this requirement. (7-1-97)

Cylinders which have definite visible bulges shall be removed from service and evaluated. Cylinders shall be rejected when a variation of one (1) percent or more is found in the measured circumferences or in peripheral distances measured from the valve spud to the center seam (or equivalent fixed point). (7-1-97)

Cylinder necks shall be examined for serious cracks, folds, and flaws. Cracks in the neck are normally detected by leak testing the neck during charging operations with a soap solution. (7-1-97)

Cylinder neck threads shall be examined whenever the valve is removed from the cylinder. Cylinders shall be rejected if the required number of effective threads is materially reduced, or if a gas tight seal cannot be obtained by reasonable valving methods. Gages shall be used to measure the number of effective threads. (7-1-97)

If the valve is noticeably tilted, the cylinder shall be rejected. (7-1-97)

The footring and headring of cylinders may become so distorted through service abuse that they no longer perform their functions: to cause the cylinder to remain stable and upright or to protect the valve. Rings shall be examined for distortion, for looseness, and for failure of welds. Footrings and/or headrings that do not meet these requirements shall be cause for rejection of the cylinder. (7-1-97)

05. Low-pressure Cylinders Subject to Hydrostatic Testing: (7-1-97)

Cylinders covered in this subsection are low-pressure cylinders other than those covered in sub-section 210.04 of this section. They differ essentially from such cylinders in that they require a periodic hydrostatic retest which will include an internal and external examination. (7-1-97)
b. Defect limits, for the external examination of cylinders covered in this subsection, are prescribed in sub-section 210.04 of this section, with exceptions for aluminum cylinders which are covered in sub-section 210.05 of this section. (7-1-97)

c. Flammable gas cylinders shall be purged before being examined with a light. Lamps used for flammable gas cylinder inspection shall be explosion proof. (7-1-97)

d. Cylinders shall be inspected internally at least every time the cylinder is periodically retested. The examination shall be made with a light of sufficient intensity to clearly illuminate the interior walls. (7-1-97)

e. The external inspection of aluminum cylinders shall meet the inspection requirements of sub-section 210.04 of this section, except as follows: Aluminum cylinders shall be rejected when impairment to the surface (corrosion or mechanical defects) exceeds a depth where the remaining wall is less than three-fourths (3/4) of the minimum allowable wall thickness required by the specification under which the cylinder was manufactured. Aluminum cylinders subjected to the action of fire shall be removed from service. (7-1-97)

06. High-pressure Cylinders: (7-1-97)

a. Prior to inspection cylinders shall be cleaned so that the inside and outside surfaces and all conditions can be observed. This shall include removal of scale and caked paint from the exterior and the thorough removal of internal scale. Cylinders with interior coating shall be examined for defects in the coating. If the coating is defective, it shall be removed. (7-1-97)

b. A good inspection light of sufficient intensity to clearly illuminate the interior wall is mandatory for internal inspection. Flammable gas cylinders shall be purged before being examined with a light. Lamps for flammable gas cylinder inspection shall be explosion proof. NOTE: To fix corrosion limits for all types, designs, and sizes of cylinders, and include them in this section, is not practicable. Considerable judgment is required in evaluating cylinders fit for service. Experience is a major factor, aside from strength considerations for high pressure cylinders. (7-1-97)

c. When the original wall thickness of the cylinder is not known and the actual wall thickness cannot be measured, the cylinder shall be rejected if corrosion exceeds one-thirty-seconds (1/32) inch in depth. This is arrived at by subtracting from the minimum allowable wall at manufacture zero point-two-two-one (0.221) inch, the limiting wall in service zero point one-nine-five (0.195) inch, to give the maximum allowable corrosion limit of zero point zero-two-six (0.026) inch, the equivalent of one-thirty-second (1/32) inch. (7-1-97)

d. When the wall thickness is known, or the actual wall thickness is measured, the difference between this known wall and the limiting value establishes the maximum corrosion figure. The normal hot forged cylinder of this size will have a measured wall of about zero point two-five-zero (0.250) inch. Comparison of this with the limiting wall thickness shows that defects up to about one-sixteenth (1/16) inch are allowable provided, of course, that the actual wall is measured or is known. (7-1-97)
e. Cylinders with general corrosion are evaluated by subjecting them to a hydrostatic test. Thus, a cylinder with an elastic expansion of two-hundred-twenty-seven (227) cubic centimeters or greater shall be rejected. If areas of pronounced pitting are included within the general corrosion, the depth of such pitting should also be measured (with the high spots of the actual surface as a reference point) and the criteria established in the first example apply. Thus, the maximum corrosion limit would be one-thirty-second (1/32) inch when the wall was not known. (7-1-97)

f. Any defect of appreciable depth having a sharp bottom is a stress point and even though a cylinder may be acceptable from a stress standpoint, it is common practice to remove such defects. After any such repair operation, verification of the cylinder strength and structure shall be made by hydrostatic test of other suitable means. (7-1-97)

g. Dents can be tolerated when the cylinder wall is not deformed excessively or abruptly. Generally speaking, dents are accepted up to a depth of about one-sixteenth (1/16) inch when the major diameter of the dent is equal to or greater than thirty-two (32) times the depth of the dent. Sharper dents than this are considered too abrupt and shall require rejection of the cylinder. On small diameter cylinders, these general rules may have to be adjusted. Considerations of appearance play a major factor in the evaluation of dents. (7-1-97)

h. Cylinders with arc or torch burns shall be removed from service. Defects of this nature may be recognized by one of the following conditions: Removal of metal by scarifying or cratering; a sentering of burning of the base metal; a hardened heat affected zone. A simple method for verifying the presence of small burns is to file the suspected area. The hardened zone will resist filing as compared to the softer base metal. (7-1-97)

i. Cylinders are normally produced with a symmetrical shape. Cylinders with distinct visual bulges shall be removed from service until the nature of the defect is determined. Some cylinders may have small discontinuities related to the manufacturing process; mushroomed bottoms, offset shoulders, etc. These usually can be identified and are not normally causes for concern. (7-1-97)

j. Cylinders shall be carefully inspected for evidences of exposure to fire in accordance with subsection 210.04.p of this section. (7-1-97)

k. Cylinder necks shall be examined for serious cracks, folds, and flaws. Cracks in the neck are normally detected by leak testing the neck during charging operations with a soap solution. (7-1-97)

07. Internal Inspection. (7-1-97)

a. Cylinders shall be inspected internally at least every time the cylinder is periodically retested. This examination shall be made with a light of sufficient intensity to clearly illuminate the interior walls. (7-1-97)

b. A hammer test shall be conducted by tapping a cylinder a light blow with a suitably sized hammer. A cylinder, emptied of liquid content, with a clean internal surface, standing free, will
have a clear ring. Cylinders with internal corrosion will give a duller ring dependent upon the amount of corrosion and accumulation of foreign material. Such cylinders shall be investigated. The hammer test is very sensitive and is an easy, quick, and convenient test that shall be made before each charging. It is an invaluable indicator of internal corrosion without the need to remove the valve. (7-1-97)

08. Safety Relief Devices for Compressed Gas Cylinders: (7-1-97)

a. Compressed gas cylinder, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with Compressed Gas Association Pamphlets S-1.1-1963 and 1965 addenda and S-1.2-1963. (7-1-97)

b. Types of safety relief devices as covered by this section are designated as follows: (7-1-97)

i. Type CG-1 Frangible disc; (7-1-97)

ii. Type CG-2 Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not more than one-hundred-seventy (170) degrees Fahrenheit nor less than one-hundred-fifty-seven (157) degrees Fahrenheit (one-hundred-sixty-five (165) degrees Fahrenheit nominal); (7-1-97)

iii. Type CG-3 Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not more than two-hundred-twenty (220) degrees Fahrenheit nor less than two-hundred-eight (208) degrees Fahrenheit (two-hundred-twelve (212) degrees Fahrenheit nominal); (7-1-97)

iv. Type CG-4 Combination frangible disc-fusible plugs, utilizing a fusible alloy with yield temperature not more than one-hundred-seventy (170) degrees Fahrenheit, nor less than one-fifty-seven (157) degrees Fahrenheit (one-hundred-sixty-five (165) degrees Fahrenheit, nominal); (7-1-97)

v. Type CG-5 Combination frangible disc fusible plug, utilizing a fusible alloy with yield temperature not more than two-hundred-twenty (220) degrees Fahrenheit nor less than two-hundred-eight (208) degrees Fahrenheit (two-hundred-twelve (212) degrees Fahrenheit nominal); (7-1-97)

vi. Type CG-7 Safety relief valve; (7-1-97)

vii. Type CG-8 Combination safety relief valve and fusible plug. (7-1-97)

c. All safety relief devices covered by this section shall meet the design, construction marking, and test specification of the "Compressed Gas Association Safety Relief Device Standards Part 1 - Cylinders for Compressed Gases: S1.1-1963." (7-1-97)

d. Compressed gas cylinders which under the Regulations of the Department of Transportation must be equipped with safety relief devices shall be considered acceptable when equipped with
devices of proper construction, location, and discharge capacity under the conditions prescribed in Table 1 of the Compressed Gas Associations Standard S-1.1-1963. (7-1-97)

e. Only replacement parts or assemblies provided by the manufacturer shall be used unless the advisability of interchange is proved by adequate tests. (7-1-97)

f. When a frangible disc is used with a compressed gas cylinder, the rated bursting pressure of the disc shall not exceed the minimum required test pressure of the cylinder with which the device is used, except for DOT-3E cylinders (49 CFR Ch. 1) the rated bursting pressure of the device shall not exceed four-thousand-five-hundred (4,500) pounds per square inch gage (p.s.i.g.). (7-1-97)

g. When a safety relief valve is used on a compressed gas cylinder, the flow rating pressure shall not exceed the minimum required test pressure of the cylinder on which the safety relief valve is installed and the reseating pressure shall not be less than the pressure in a normally charged cylinder at one-hundred-thirty (130) degrees Fahrenheit. (7-1-97)

h. When fittings and piping are used on either the upstream or downstream side or both of a safety relief device or devices, the passages shall be so designed that the flow capacity of the safety relief device will not be reduced below the capacity required for the container on which the safety relief device assembly is installed, nor to the extent that the operation of the device could be impaired. Fittings, piping and method of attachment shall be designed to withstand normal handling and the pressures developed when the device or devices function. (7-1-97)

i. No shutoff valve shall be installed between the safety relief devices and the cylinder. (7-1-97)

j. As a precaution to keep cylinder safety relief devices in reliable operating condition, care shall be taken in the handling or storing of compressed gas cylinders to avoid damage. Care shall also be exercised to avoid plugging by paint or other dirt accumulation of safety relief device channels or other parts which could interfere with the functioning of the device. Only qualified personnel shall be allowed to service safety relief devices. (7-1-97)

k. Each time a compressed gas cylinder is received at a point for refilling, all safety relief devices shall be examined externally for corrosion, damage, plugging of external safety relief device channels, and mechanical defects such as leakage or extrusion of fusible metal. If there is any doubt regarding the suitability of the safety relief device for service, the cylinder shall not be filled until it is equipped with a suitable device. (7-1-97)

**09. Storage of Gas Cylinders:** (7-1-97)

a. Cylinders shall be kept away from radiators and other sources of heat. (7-1-97)

b. Inside of buildings, cylinders shall be stored in a well protected, well ventilated, dry location, at least twenty (20) feet from highly combustible materials such as oil or excelsior. Cylinders shall be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage spaces shall be located where cylinders will not be knocked over or damaged by passing
or falling objects, or subject to tampering by unauthorized persons. Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards. (7-1-97)

c. Empty cylinders shall have their valves closed. (7-1-97)

d. Where the cylinder is designed to accept a valve protection cap, the cap shall always be in place, hand tight, except when cylinders are in use or connected for use. (7-1-97)

e. Inside a building, fuel gas cylinders except those in actual use or attached ready for use, shall be limited to a total gas capacity of two-thousand (2,000) cubic feet or three (300) pounds of liquefied petroleum gas. (7-1-97)

f. For storage of fuel gas cylinders in excess of two-thousand (2,000) cubic total gas capacity or three (300) pounds of liquefied petroleum gas, a separate room or compartment conforming to the following requirements shall be provided: (7-1-97)

i. The walls, partitions, floors, and ceiling shall be of noncombustible construction having a fire resistive rating of at least one (1) hour; (7-1-97)

ii. The walls or partitions shall be continuous from floor to ceiling and shall be securely anchored; (7-1-97)

iii. At least one (1) wall of the room or compartment shall be an exterior wall; (7-1-97)

iv. Openings from an inside storage room or compartment to other parts of the building shall be protected by a one (1) hour fire rated self closing door; and the room or compartment shall be well ventilated with vents located at floor and ceiling levels. (7-1-97)

10. Safety Relief Devices for Cargo and Portable Tanks Storing Compressed Gases. (7-1-97)

a. All safety relief devices covered by these standards shall meet the design, construction, marking, and test specifications of the "Compressed Gas Association Safety Relief Device Standards Part 2 - Cargo and Portable Tanks for Compressed Gases: S-1.2-1963." (7-1-97)

b. Each container shall be provided with one or more safety relief devices which, unless otherwise specified, shall be safety relief valves of the spring-loaded type. (7-1-97)

c. Safety relief valves shall be set to start-to-discharge at a pressure not to exceed one-hundred-ten (110) percent of the DOT design pressure of the container nor less than the DOT design pressure of the container except as follows: If an over designed container is used, the set pressure of the safety relief valve may be between the minimum required DOT design pressure for the lading and one-hundred-ten (110) percent of the DOT design pressure of the container used. For sulfur dioxide containers, a minimum set pressure of one-twenty (120) p.s.i.g and one-hundred (100) p.s.i.g. is permitted for one-hundred-fifty (150) p.s.i.g. and one-hundred-twenty-five (125) p.s.i.g., DOT design pressure containers, respectively. For carbon dioxide (refrigerated), nitrous...
oxide (refrigerated), and pressurized liquid argon, nitrogen, and oxygen, there shall be no minimum set pressure. For butadiene, inhibited, and liquefied petroleum gas containers, a minimum set pressure of ninety (90) percent of the minimum design pressure permitted for these ladings may be used. For containers constructed in accord with the Boiler and Pressure Vessel Code, the set pressure marked on the safety relief valve may be one-hundred-twenty-five (125) percent of the original DOT design pressure of the container. (7-1-97)

d. Only replacement parts or assemblies provided by the manufacturer of the device shall be used unless the suitability of interchange is proved by adequate tests. (7-1-97)

e. Safety relief valves shall have direct communication with the vapor space of the container. (7-1-97)

f. Any portion of liquid piping or hose which at any time may be closed at each end must be provided with a safety relief device to prevent excessive pressure. (7-1-97)

g. The additional restrictions of this subsection apply to safety relief devices on containers for carbon dioxide or nitrous oxide which are shipped in refrigerated and insulated containers. The maximum operating pressure in the container may be regulated by the use of one or more pressure controlling devices, which devices shall not be in lieu of the safety relief valve required in sub-section 210.08.b. of this section. (7-1-97)

h. All safety relief devices shall be so installed and located that the cooling effect of the contents will not prevent the effective operation of the device. (7-1-97)

i. In addition to the safety relief valves required by sub-section 210.08.a of this section, each container for carbon dioxide may be equipped with one or more frangible disc safety relief devices of suitable design set to function at a pressure not exceeding two (2) times the DOT design pressure of the container. (7-1-97)

j. Subject to conditions of 49 CFR 173.315 (a) (1) (DOT Regulations) for methyl chloride and sulfur dioxide optional portable tanks of two-hundred-twenty-five (225) p.s.i.g. minimum DOT design pressure, one or more fusible plugs approved by the Bureau of Explosives, 63 Vesey Street, Ne York, NY 10007, may be used in lieu of safety relief valves of the spring-loaded type. If the container is more than thirty (30) inches long, a safety relief device having the total required flow capacity must be at both ends. (7-1-97)

k. When storage containers for liquefied petroleum gas are permitted to be shipped in accordance with 49 CFR 173.315 (j) (DOT Regulations), they must be equipped with safety relief devices in compliance with the requirements for safety relief devices on aboveground containers as specified in the National Fire Protection Association Pamphlet No. 58-1969 "Standard for the Storage and Handling of Liquefied Petroleum Gases." (7-1-97)

l. When containers are filled by pumping equipment which has a discharge capacity in excess of the capacity of the container safety relief devices, and which is capable of producing pressures in excess of DOT design pressure of the container, precautions should be taken to prevent the
development of pressures in the container in excess of one-hundred-twenty (120) percent of its DOT design pressure. This may be done by providing additional capacity of the safety relief valves on the container by providing a bypass on the pump discharge, or by any other suitable method. (7-1-97)

m. This additional requirement applies to safety relief devices on containers for liquefied hydrogen and pressurized liquid argon, nitrogen, and oxygen. The liquid container shall be protected by one or more safety relief valves and one or more frangible discs. (7-1-97)

n. Safety relief devices shall be arranged to discharge unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container. Safety relief devices shall be arranged to discharge upward, except this is not required for carbon dioxide, nitrous oxide, pressurized liquid argon, nitrogen, and oxygen. (7-1-97)

o. No shutoff valves shall be installed between the safety relief devices and the container except, in cases where two or more safety relief devices are installed on the same container, a shutoff valve may be used where the arrangement of the shutoff valve or valves is such as always to insure full required capacity flow through at least one safety relief device. (7-1-97)

11. Maintenance Requirements for Safety Relief Devices. (7-1-97)

a. Care shall be exercised to avoid damage to safety relief devices. Care shall also be exercised to avoid plugging by paint or other dirt accumulation of safety relief device channels or other parts which could interfere with the function of the device. (7-1-97)

b. Only qualified personnel shall be allowed to service safety relief devices. Any servicing or repairs which require resetting of safety relief valves shall be done only by or after consultation with the valve manufacturer. (7-1-97)

c. Safety relief devices periodically shall be examined externally for corrosion damage, plugging, or external safety relief device channel and mechanical defects such as leakage or extrusion of fusible metal. Valves equipped with secondary resilient seals shall have the seals inspected periodically. If there is any doubt regarding the suitability of the safety relief device for service, the container shall not be filled until it is equipped with a suitable safety relief device. (7-1-97)

12. Air Receivers. (7-1-97)

a. This subsection applies to compressed air receivers, and other equipment used in providing and utilizing compressed air for performing operations such as cleaning, drilling, hoisting, chipping and air operated controls. On the other hand, however, this section does not deal with the special problems created by using compressed air to convey materials nor the problems created when people work in compressed air as in tunnels and caissons. (7-1-97)

b. This subsection is not intended to apply to compressed air machinery and equipment used on transportation vehicles such as steam railroad cars, electric railway cars, and automotive equipment. (7-1-97)
c. All new air receivers installed after January 1, 1961 shall be constructed in accordance with the ASME Boiler and Pressure Vessel Code. (7-1-97)

d. All safety valves used shall be constructed, installed and maintained in accordance with the ASME Boiler and Pressure Vessel Code. (7-1-97)

e. Air receivers shall be so installed that all drains, hand holes, and manholes therein are easily accessible. Air receivers shall be supported with sufficient clearance to permit a complete external inspection and to avoid corrosion of external surfaces. Under no circumstances shall an air receiver be buried underground or located in an inaccessible place. The receiver should be located as close to the compressor or after-cooler as is possible in order to keep the discharge pipe short. (7-1-03)

f. A drain pipe and valve shall be installed at the lowest point of every air receiver to provide for the removal of accumulated oil and water. Adequate automatic traps may be installed in addition to drain valves. The drain valve on the air receiver shall be opened and the receiver completely drained frequently and at such intervals as to prevent the accumulation of excessive amounts of liquid in the receiver. (7-1-97)

g. Air receivers five and one-half (5 1/2) cubic feet or larger, or with an operating pressure of two-hundred-fifty (250) p.s.i. or greater shall receive an inspection by a boiler and pressure vessel inspector holding a current state commission every three (3) years. Inspections shall be conducted and certificates issued as required under the provisions of IDAPA 17.04.06. (7-1-97)

h. Every air receiver shall be equipped with an indicating pressure gage (so located as to be readily visible) and with one or more spring-loaded safety valves. The total relieving capacity of such safety valves shall be such as to prevent pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than ten (10) percent. (7-1-97)

i. No valve of any type shall be placed between the air receiver and its safety valve or valves. (7-1-97)

j. Safety appliances, such as safety valves, indicating devices and controlling devices, shall be constructed, located and installed so that they cannot be readily rendered inoperative by any means, including the elements. (7-1-97)

k. All safety valves shall be tested frequently and at regular intervals to determine whether they are in good operating condition. (7-1-97)

l. Piping, tubing, hoses, and fittings shall be suitable for compressed air service and for the pressures and temperatures involved. Cast iron pipe and fittings shall not be used. Plastic pipe, when used, shall be protected from ultra-violet rays and the internal pressure in the pipe shall not exceed 150 p.s.i.g. Plastic piping and fittings used in compressed air service shall be inspected at least annually for signs of stress, expansion, cracking, or deterioration. If these conditions are found to exist, the plastic pipe and/or fittings, it shall be immediately taken out of service. Cast iron pipe and fittings shall not be used. (7-1-03)
13. Acetylene: (7-1-97)

a. The in plant transfer, handling, storage and utilization of acetylene in cylinders shall be in accordance with Compressed Gas Association Pamphlet G-1. (7-1-97)

b. The piped systems for the in plant transfer and distribution of acetylene shall be designed, installed, maintained and operated in accordance with Compressed Gas Association Pamphlet G-1.3. (7-1-97)

c. Under no condition shall acetylene be generated, piped (except in approved cylinder manifolds) or utilized at a pressure in excess of fifteen (15) psi gage pressure or thirty (30) psi absolute pressure. (The thirty (30) psi absolute pressure limit is intended to prevent unsafe use of acetylene in pressurized chambers such as caissons, underground excavations or tunnel constructions.) This requirement does not apply to storage of acetylene dissolved in a suitable solvent in cylinders manufactured and maintained according to U.S. Department of Transportation requirements, or to acetylene for chemical use. The use of liquid acetylene shall be prohibited. (7-1-97)

d. Acetylene cylinders shall be stored valve end up. (7-1-97)

e. Nothing shall be placed on top of an acetylene cylinder when in use which may damage the safety device or interfere with the quick closing of the valve. (7-1-97)

f. An acetylene cylinder valve shall not be opened more than 1 1/2-turns of the valve spindle, and preferably no more than 3/4-of a turn. (7-1-97)

14. Chlorine: (7-1-97)

a. Respiratory shall be worn under the following conditions: (7-1-97)

i. As a minimum a respirator shall be worn when chlorine gas concentration is above one (1) ppm; (7-1-97)

ii. A self contained breathing apparatus (SCBA) shall be worn when chlorine gas concentration is twenty-five (25) ppm or greater; (7-1-97)

iii. A self contained breathing apparatus (SCBA) shall be worn for sealing leaks, or for entry, escape, or rescue in unknown concentrations. (7-1-97)

b. Chlorine cylinder valves shall not be opened more than one (1) turn. (7-1-97)

c. A wrench longer than eight (8) inches long shall not be used on the cylinder valve. (7-1-97)

d. The valve wrench shall be left on the valve for emergency shut off. (7-1-97)
e. Leak detection shall be by means of ammonia vapors allowed to flow around valves fittings, or suspected leaks (a white cloud will form where ever there is a chlorine leak present). (7-1-97)

f. Leaking containers shall be positioned so that only gas escapes if possible. (7-1-97)

g. Piping, valves, and containers shall be capped off or closed when not in use to keep moisture out. (7-1-97)

h. Chlorine cylinders shall be moved only with proper equipment (lifting bars, hand trucks, etc.) and secured while moving. (7-1-97)

i. Critical isolation valves shall be conspicuously marked and access kept unobstructed. (7-1-97)

j. No employee shall be permitted to work alone with chlorine. There shall always be a second person located within the immediate area outside the work area with eye contact on the worker. The safety person shall have the required protective equipment to assist the worker to fresh air that is up wind to the chlorine in the event of an emergency. The safety person shall not assist in maintenance or re-enter the area to shut off cylinders in the event of a major leak. (7-1-97)

k. Employees working on the chlorine system under normal conditions shall have the following personal protective equipment as a minimum: chemical goggles and face shield; an approved respirator with an approved canister for chlorine (NOTE a respirator is only good for about ten (10) minutes in atmospheres having one (1) to two (2) percent chlorine); and impervious gloves. A respirator will afford protection under normal conditions should a small amount of chlorine trapped in a line be released when making or breaking connections. (7-1-97)

l. Impervious gloves shall be worn when ever working on chlorine. Moisture from hands will form hydrochloric acid if chlorine is present and cause skin burns. (7-1-97)

m. Self contained breathing apparatus (SCBA) shall be used by both the employee(s) making repairs on leaks and the safety person. The safety person shall remain in the clear maintaining eye contact with the worker(s) so as to render assistance in an emergency in removing the worker(s) to fresh air. The safety person shall not assist in shutting down, leak sealing, or any other maintenance. The sole purpose of the safety person shall be to rescue the worker(s) should the need arise. (7-1-97)

n. Chlorine cylinders shall be separated from other areas in an unoccupied room or specifically designed cabinet that is adequately ventilated and be of one (1) hour fire resistive construction. (7-1-97)

o. The entry door to the chlorine room shall be from the outside with a small window installed to allow viewing of the interior prior to entry. Any light switch shall be located outside of the chlorine room. (7-1-97)

p. Chlorine rooms or specifically designed cabinet shall be equipped with a chlorine gas detector with an outside visible/audible alarm. (7-1-97)
q. The chlorine room or specifically designed cabinet shall be equipped with a fan that draws from the floor and exhausts to a safe area. In order to have an air change, make-up air shall be drawn in at the upper part of the room. The switch to control the ventilation fan shall be located outside the room by the entry door. (7-1-97)

r. All chlorine rooms, buildings, and areas shall be posted with a danger sign, see Figure 210.14-A. (7-1-97)

FIGURE 210.14-A

s. Chlorine cylinders stored outside shall be protected from flame, heat, etc. Cylinders shall be protected from moisture (exposed to moisture corrode rapidly and bring out weak spots). (7-1-97)

15. Hydrogen: (7-1-97)

a. Hydrogen containers shall comply with one of the following: Designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, or Designed, constructed, tested, and maintained in accordance with U.S. Department of Transportation Specifications and Regulations. (7-1-97)

b. Permanently installed containers shall be provided with substantial noncombustible supports on firm, noncombustible foundations. (7-1-97)

c. Each portable container shall be legibly marked with the name "Hydrogen" in accordance with "Marking Compressed Gas Containers to Identify the Material Contained" ANSI Z48.1. Each manifolded hydrogen supply unit shall be legibly marked with the name "Hydrogen" or a legend such as "This unit contains hydrogen." (7-1-97)

d. Hydrogen containers shall be equipped with safety relief devices as required by the ASME Boiler and Pressure Vessel Code, or the DOT Specifications and Regulations under which the container is fabricated. (7-1-97)

e. Safety relief devices shall be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container, adjacent
structures, or personnel. This requirement does not apply to DOT Specification containers having an internal volume of two (2) cubic feet or less. (7-1-97)

f. Safety relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device. (7-1-97)

g. Piping, tubing, and fittings shall be suitable for hydrogen service and for the pressures and temperatures involved. Cast iron pipe and fittings shall not be used. (7-1-97)

h. Piping and tubing shall conform to Section 2 - "Industrial Gas and Air Piping" - Code for Pressure Piping, ANSI B31.1 with addenda B31.1. (7-1-97)

i. Joints in piping and tubing may be made by welding or brazing or by use of a flange, threaded socket, or compression fittings. Gaskets and thread sealants shall be suitable for hydrogen service. (7-1-97)

j. Valves, gauge, regulators, and other accessories shall be suitable for hydrogen service. (7-1-97)

k. Installation of hydrogen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use. (7-1-97)

l. Storage containers, piping, valves, regulating equipment and other accessories shall be readily accessible and shall be protected against physical damage and against tampering. (7-1-97)

m. Cabinets or housings containing hydrogen control or operating equipment shall be adequately ventilated. (7-1-97)

n. Each mobile hydrogen supply unit used as part of a hydrogen system shall be adequately secured to prevent movement. (7-1-97)

o. Mobile hydrogen supply units shall be electrically bonded to the system before discharging hydrogen. (7-1-97)

p. The hydrogen storage location shall be permanently placarded as follows: "HYDROGEN-FLAMMABLE GAS-NO SMOKING-NO OPEN FLAMES" or equivalent. (7-1-97)

q. After installation, all piping, tubing, and fittings shall be tested and proved hydrogen gas tight at maximum operating pressure. (7-1-97)

r. The hydrogen system shall be located so that it is readily accessible to delivery equipment and to authorized personnel. (7-1-97)

s. Hydrogen systems shall be located above ground. (7-1-97)

t. Hydrogen systems shall not be located beneath electrical power lines. (7-1-97)
u. Hydrogen systems shall not be located close to flammable liquid piping or piping of other flammable gases. (7-1-97)

v. Systems near aboveground flammable liquid storage shall be located on ground higher than the flammable liquid storage except when dikes, diversion curbs, grading, or separating solid walls are used to prevent accumulation of flammable liquids under the system. (7-1-97)

w. The location of a system, as determined by the maximum total contained volume of hydrogen, shall be in the order of preference as indicated by Roman Numerals in Table 210.15-A. (7-1-97)

<table>
<thead>
<tr>
<th>Nature of Location</th>
<th>Size of Hydrogen system</th>
<th>3,000 CF to 15,000 CF</th>
<th>In excess of 15,000 CF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoors</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>In a separate building</td>
<td>II</td>
<td>II</td>
<td>II</td>
</tr>
<tr>
<td>In a special room</td>
<td>III</td>
<td>III</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Inside buildings not in a special room and exposed to other occupancies</td>
<td>IV</td>
<td>Not permitted</td>
<td>Not permitted</td>
</tr>
</tbody>
</table>

x. The minimum distance in feet from a hydrogen system of indicated capacity located outdoors, in separate buildings or in special rooms to any specified outdoor exposure shall be in accordance with Table 210.15-A. (7-1-97)

y. The distance in Table 210.15-B, items 1, 14, 3 to 10 inclusive do not apply where protective structures such as adequate fire walls are located between the system and the exposure. (7-1-97)

z. Hydrogen systems of less than three-thousand (3,000) cubic feet when located inside buildings and exposed to other occupancies shall be situated in the building so that the system will be as follows: in an adequately ventilated area as in sub-section 210.15.a through sub-section 210.15.jj; twenty (20) feet from stored flammable materials or oxidized gases; twenty-five (25) feet from open flames, ordinary electrical equipment, or other sources of ignition; twenty-five
(25) feet from concentration of people; fifty (50) feet from an intake of ventilation or air-conditioning equipment and air compressors; Fifty (50) feet from other flammable gas storage; protected against damage or injury due to falling objects or working activity in the area; more than one system of three-thousand (3,000) cubic feet or less may be installed in the same room, provided the systems are separated by at least fifty (50) feet. Each such system shall meet all of the requirements of this section. (7-1-97)

aa. Outdoor locations where protective walls or roofs are provided, they shall be constructed of noncombustible materials. (7-1-97)

bb. Outdoor locations where the enclosing sides adjoin each other, the area shall be properly ventilated. (7-1-97)

c. Outdoor locations with electrical equipment within fifteen (15) feet shall be in accordance with section 150 of this standard. (7-1-97)

dd. Separate buildings shall be built of at least noncombustible construction. Windows and doors shall be located so as to be readily accessible in case of an emergency. Windows shall be of glass or plastic in metal frames. (7-1-97)

e. Adequate ventilation to the outdoors shall be provided. Inlet openings shall be located near the floor in exterior walls only. Outlet openings shall be located at the high point of the room in exterior walls or roof. Inlet and outlet openings shall each have minimum total area of one (1) square foot per one-thousand (1,000) cubic feet of room volume. Discharge from outlet openings shall be directed or conducted to a safe location. (7-1-97)

<table>
<thead>
<tr>
<th>Type of outdoor exposure</th>
<th>Size of hydrogen system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 3,000 CF</td>
</tr>
<tr>
<td>Wood frame construction¹</td>
<td>10</td>
</tr>
<tr>
<td>Heavy timber, non combustible or ordinary construction¹</td>
<td>0</td>
</tr>
<tr>
<td>Fire resistive construction¹</td>
<td>0</td>
</tr>
</tbody>
</table>

1 Building or structure Fire resistive construction¹

Compressed Gas 210
<table>
<thead>
<tr>
<th></th>
<th>Item Description</th>
<th>0 to 1,000 gallons</th>
<th>In excess of 1,000 gallons</th>
<th>Tank</th>
<th>In excess of 15,000 CF capacity</th>
<th>12,000 CF or less</th>
<th>More than 12,000 CF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Wall openings</td>
<td>Not above any part of a system</td>
<td>Above any part of a system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Flammable liquids above ground</td>
<td>0 to 1,000 gallons</td>
<td>In excess of 1,000 gallons</td>
<td>Tank</td>
<td>In excess of 15,000 CF capacity</td>
<td>12,000 CF or less</td>
<td>More than 12,000 CF</td>
</tr>
<tr>
<td>4</td>
<td>Flammable liquids below ground - 0 to 1,000 gallons</td>
<td></td>
<td></td>
<td>Tank</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Flammable liquids below ground - in excess of 1,000 gal.</td>
<td></td>
<td></td>
<td>Tank</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Flammable gas storage, either high pressure or low pressure</td>
<td>0 to 15,000 CF capacity</td>
<td>In excess of 15,000 CF capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Oxygen storage</td>
<td>12,000 CF or less</td>
<td>Refer to NFPA No. 51, gas systems for welding and cutting (1969)</td>
<td></td>
<td>Refer to NFPA No. 566, bulk oxygen systems at consumer sites (1969)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Fast burning solids such as ordinary lumber, excelsior or paper</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Slow burning solids such as heavy timber or coal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Open flames and other sources of ignition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Air compressor intakes or inlets to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ff. Explosion venting shall be provided in exterior walls or roof only. The venting area shall be equal to not less than one (1) square foot per thirty (30)-cubic feet of room volume and may consist of any one (1) or any combination of the following: walls of light noncombustible material, preferably single thickness, single strength glass; lightly fastened hatch covers; lightly fastened swinging doors in exterior walls opening outward; lightly fastened walls or roof designed to relieve at a maximum pressure of twenty-five (25) pounds per square foot. (7-1-97)

gg. There shall be no sources of ignition from open flames, electrical equipment, or heating equipment. (7-1-97)

hh. Electrical equipment shall be in accordance with section 150 of this standard for Class I, Division 2 locations. (7-1-97)

ii. Heating, if provided, shall be by steam, hot water, or other indirect means. (7-1-97)

jj. Special room floors, walls, and ceiling shall have a fire-resistance rating of at least two (2) hours. Walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall shall be an exterior wall. Openings to other parts of the building shall not be permitted. Windows and doors shall be in exterior walls and shall be located so as to be readily accessible in case of an emergency. Windows shall be of glass or plastic in metal frames. (7-1-97)

kk. For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations. (7-1-97)

ll. The equipment and functioning of each charged gaseous hydrogen system shall be maintained in a safe operating condition in accordance with the requirements of this section. The area within fifteen (15) feet of any hydrogen container shall be kept free of dry vegetation and combustible material. (7-1-97)
16. Oxygen: (7-1-97)

a. Oxygen cylinders shall not be stored near highly combustible material, especially oil and grease, or near any other substance likely to cause or accelerate fire. (7-1-97)

b. Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials (especially oil or grease), a minimum of twenty (20) feet or by a noncombustible barrier at least five (5) feet high having a fire resistive rating of at least one-half (1/2) hour. (7-1-97)

c. Oxygen cylinders, cylinder valves, couplings, regulators, hose, piping, and apparatus shall be kept free from oily or greasy substances. Oxygen cylinders or apparatus shall not be handled with oily hands or gloves. A jet of oxygen shall never be permitted to strike any oily surface, greasy clothes, or enter a fuel oil or other storage tank. (7-1-97)

d. Oxygen shall never be vented into a confined space or other area to enrich the atmosphere. (7-1-97)

e. Bulk oxygen storage systems shall be located above ground out of doors, or shall be installed in a building of noncombustible construction, adequately vented, and used for that purpose exclusively. The location selected shall be such that containers and associated equipment shall not be exposed to electric power line, flammable or combustible liquid lines, or flammable gas lines. (7-1-97)

f. The system shall be located so that it is readily accessible to mobile supply equipment at ground level and to authorized personnel. (7-1-97)

g. Where oxygen is stored as liquid, noncombustible surfacing shall be provided in an area in which any leakage of liquid oxygen might fall during operation of the system and filling of a storage container. For purposes of this subsection, asphaltic or bituminous paving is considered to be combustible. (7-1-97)

h. When locating bulk oxygen systems near above ground flammable or combustible liquid storage which may be either indoors or outdoors, it is advisable to locate the system on ground higher than the flammable or combustible liquid storage. (7-1-97)

i. Where it is necessary to locate a bulk oxygen system on ground lower than adjacent flammable or combustible liquid storage, suitable means shall be taken (such as dikes, diversion curbs, or grading) with respect to the adjacent flammable or combustible liquid storage to prevent accumulation of liquids under the bulk oxygen system. (7-1-97)

j. The minimum distance from any bulk oxygen storage container to exposures, measured in the most direct line except as indicated in Table 210.16-B and Table 210.16-C shall be indicated in sub-section 210.16.k through 210.16.y. of this section. (7-1-97)

k. Fifty (50) feet from any combustible structure. (7-1-97)
l. Twenty-five (25) feet from any structures with fire-resistive exterior walls or sprinklers installed in buildings or other construction, but not less than one-half (1/2) the height of an adjacent side wall of the structure. (7-1-97)

m. At least ten (10 feet from any opening in adjacent walls or fire resistive structures. Spacing from such structures shall be adequate to permit maintenance, but shall not be less than one (1) foot. (7-1-97)

n. Flammable liquid storage above ground, see Table 210.16-A. (7-1-97)

<table>
<thead>
<tr>
<th>TABLE 210.16-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (feet)</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>90</td>
</tr>
</tbody>
</table>

o. Flammable liquid storage below ground, see Table 210.16-B. (7-1-97)

<table>
<thead>
<tr>
<th>TABLE 210.16-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance measured horizontally from oxygen storage container to flammable liquid tank (feet)</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>30</td>
</tr>
</tbody>
</table>

p. Combustible liquid storage above ground, see Table 210.16-C. (7-1-97)

<table>
<thead>
<tr>
<th>TABLE 210.16-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (feet)</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

q. Combustible liquid storage below ground, see Table 210.16-D. (7-1-97)
### TABLE 210.16-D

<table>
<thead>
<tr>
<th>Distance measured horizontally from oxygen storage container to combustible liquid tank (feet)</th>
<th>Distance from oxygen storage container to filling and vent connections or openings to combustible liquid tank (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>40</td>
</tr>
</tbody>
</table>

**r.** Flammable gas storage. (Such as compressed flammable gases, liquefied flammable gases and flammable gases in low pressure gas holder), see Table 210.16-E. (7-1-97)

### TABLE 210.16-E

<table>
<thead>
<tr>
<th>Distance (feet)</th>
<th>Capacity (cu. ft. N.T.P.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Less than 5,000</td>
</tr>
<tr>
<td>90</td>
<td>5,000 or more</td>
</tr>
</tbody>
</table>

**s.** Fifty (50) feet from solid materials which burn rapidly, such as excelsior or paper. (7-1-97)

**t.** Twenty-five (25) feet from solid materials which burn slowly, such as coal and heavy timber. (7-1-97)

**u.** Ventilation shall be seventy-five (75) feet in one direction and thirty-five (35) feet in approximately ninety (90) degree direction from confining walls (not including fire walls less than twenty (20) feet high) to provide adequate ventilation in courtyards and similar confining areas. (7-1-97)

**v.** Twenty-five (25) feet from congested areas such as offices, lunchrooms, locker rooms, time clock areas and similar locations where people may congregate. (7-1-97)

**w.** Fifty (50) feet from places of public assembly. (7-1-97)

**x.** Fifty (50) feet from areas occupied by patients who are not ambulatory. (7-1-97)

**y.** Ten (10) feet from any pubic sidewalk. (7-1-97)

**z.** Five (5) feet from any line of adjoining property. (7-1-97)

**aa.** Exceptions. The distance in Subsection 210.16.k., 210.16.l., 210.16.n. through 210.16.p. inclusive and Subsection 210.16.u. and 210.16.v. do not apply where protective structures such as fire walls of adequate height to safeguard the oxygen storage systems are located between the bulk oxygen storage installations and the exposure. In such cases, the bulk oxygen storage may be a minimum distance of one (1) foot from the firewall. (7-1-97)
bb. Permanently installed containers shall be provided with substantial noncombustible supports on firm noncombustible foundations. (7-1-97)

c. Liquid oxygen storage containers shall be fabricated from materials meeting the impact test requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels. Containers operating at pressures above one-hundred-sixty-five (165) pounds per square inch gage (p.s.i.g.) shall be designed, constructed and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels. Insulation surrounding the liquid oxygen container shall be noncombustible. (7-1-97)

dd. High-pressure gaseous oxygen containers shall comply with one of the following: designed, constructed and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels; or Designed, constructed, tested, and maintained in accordance with DOT Specifications and Regulations. (7-1-97)

ee. Piping, tubing, and fittings shall be suitable for oxygen service and for the pressures and temperatures involved. (7-1-97)

ff. Piping and tubing shall conform to Section 2 - Gas and Air Piping Systems of Code for Pressure Piping, ANSI B31.1. (7-1-97)

gg. Piping or tubing for operating temperatures below minus twenty (-20) degrees Fahrenheit shall be fabricated from materials meeting the impact test requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels, when tested at the minimum operating temperature to which the piping may be subjected in service. (7-1-97)

hh. Bulk oxygen storage containers, regardless of design pressure shall be equipped with safety relief devices as required by the ASME code or the DOT specifications and regulations. (7-1-97)

ii. Bulk oxygen storage containers designed and constructed in accordance with DOT specifications shall be equipped with safety relief devices as required thereby. (7-1-97)

jj. Bulk oxygen storage containers designed and constructed in accordance with ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels shall be equipped with safety relief devices meeting the provisions of the Compressed Gas Association Pamphlet "Safety Relief Device Standards for Compressed Gas Storage Containers," S-1, Part 3. (7-1-97)

kk. Insulation casings on liquid oxygen containers shall be equipped with suitable safety relief devices. (7-1-97)

ll. All safety relief devices shall be so designed or located that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device. (7-1-97)

mm. Liquid oxygen vaporizers shall be anchored and connecting piping be sufficiently flexible to provide for the effect of expansion and contraction due to temperature changes. (7-1-97)
nn. Liquid oxygen vaporizers and piping shall be adequately protected on the oxygen and heating medium sections with safety relief devices. (7-1-97)

oo. Heat used in an oxygen vaporizer shall be indirectly supplied only through media such as steam, air, water, or water solutions which do not react with oxygen. (7-1-97)

pp. If electric heaters are used to provide the primary source of heat, the vaporizing system shall be electrically grounded. (7-1-97)

qq. Equipment making up a bulk oxygen system shall be cleaned in order to remove oil, grease, or other readily oxidizable materials before placing the system in service. (7-1-97)

rr. Joints in piping and tubing may be made by welding or by use of flanged, threaded, slip, or compression fittings. Gaskets or thread sealants shall be suitable for oxygen service. (7-1-97)

ss. Valves, gages, regulators, and other accessories shall be suitable for oxygen service. (7-1-97)

tt. Installation of bulk oxygen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use. (7-1-97)

uu. After installation, all field erected piping shall be tested and proved gas tight at maximum operating pressure. Any medium used for testing shall be oil free and nonflammable. (7-1-97)

vv. Storage containers, piping, valves, regulating equipment and other accessories shall be protected against physical damage and against tampering. (7-1-97)

ww. Any enclosure containing oxygen control or operating equipment shall be adequately vented. (7-1-97)

xx. The bulk oxygen storage location shall be permanently placarded to indicate: "OXYGEN - NO SMOKING - NO OPEN FLAMES" or an equivalent warning. (7-1-97)

yy. Bulk oxygen installations are not hazardous locations as defined and covered in section 150 of this standard. Therefor, general purpose or weather proof types of electrical wiring and equipment are acceptable depending upon whether the installation is interior or exterior. Such equipment shall be installed in accordance with the applicable provisions of section 150 of this standard. (7-1-97)

zz. For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations. (7-1-97)

aaa. The equipment and functioning of each charged bulk oxygen system shall be maintained in a safe operating condition in accordance with the requirements of this Section. Wood and long dry grass shall be cut back within fifteen (15) feet of any bulk oxygen storage container. (7-1-97)

17. Nitrous Oxide: (7-1-97)
a. The piped systems for the in-plant transfer and distribution of nitrous oxide shall be designed, installed, maintained, and operated in accordance with Compressed Gas Association Pamphlet G8 1964. (7-1-97)

211.-219. (RESERVED)